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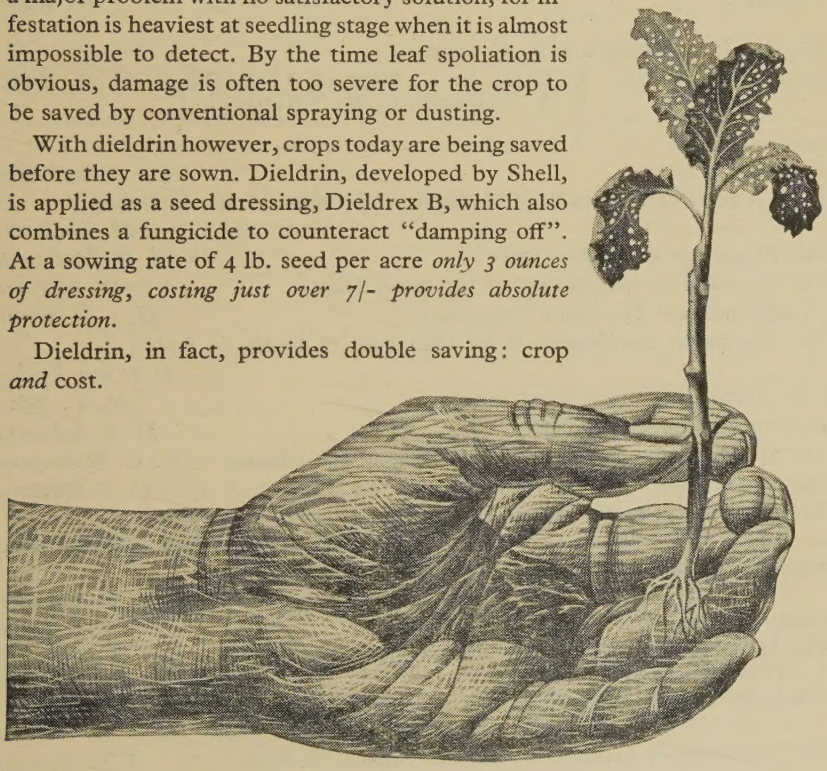

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GRANT AVENUE, PALO ALTO, CALIFORNIA, U.S.A.

Whellan (J. A.). **The African Army Worm and its Control.**—*Rhod. agric. J.* **51** no. 6 pp. 415–427, 3 pls., 4 refs.; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1792, 15 pp., 3 pls., 4 refs. Salisbury, S. Rhod., 1954.

A widespread outbreak of *Laphygma exempta* (Wlk.) occurred in Southern Rhodesia in the summer of 1953–54. Severe damage was caused to maize, other cereal crops, and pasture and forage grasses, but synthetic insecticides proved very effective for control and losses were lighter than expected. The bionomics of this armyworm are reviewed, and the terms passive and active are preferred to solitary and gregarious for the designation of the two phases of the larvae [*cf. R.A.E.*, A **32** 285], since those in the passive or solitary phase often occur in considerable aggregations, ranging from 7 to 14 per sq. ft. It was observed that almost all the adults of some broods were females, and these reproduced parthenogenetically, ovipositing shortly after emergence. In other broods, males and females were present in about equal numbers, and pairing and a preoviposition period of at least two days were necessary before the females laid their eggs. No evidence was obtained of how the dry season was passed, young larvae that hatched in May died without completing their development, and pupae from the April generation that appeared to have survived the winter satisfactorily were found in spring to be parasitised by a Braconid, which emerged in November. The evidence points to a complete dying out of the population in the dry season, except possibly in very favourable localities.

Parasites belonging to 18 species, including 12 species of Hymenoptera, were reared from *Laphygma* during and after the outbreak, but little is known of their life-histories. The outbreak generation was only lightly parasitised, but the succeeding generation was so heavily attacked that few of the larvae completed their development. The fact that the parasites required some time to become numerous lends support to the view that outbreaks of the armyworm are the result of adult migration; if this is so, the movement is probably from north to south, since the moths were observed earlier in Nyasaland and later in South Africa than in Southern Rhodesia.

Examination of rainfall figures for January 1954 and January 1930, when a severe outbreak also occurred [*cf.* **19** 57], produced no evidence of any direct relation between these and the occurrence of outbreaks. Considerable numbers of adults, mostly females, were found sheltering in low heaps of abandoned partly-grown maize plants a few days before larvae were observed in adjacent fields. Some adults were present in the fields, but the majority congregated in the heaps, and the placing of these round maize fields is suggested for the forecasting of outbreaks. It is thought that heaps of grass would prove equally attractive. Control measures are briefly reviewed. In tests against the larvae, complete or almost complete mortality was given by sprays of 5 pints of an emulsion product containing 27·5 per cent. DDT, 3–4 lb. of a 50 per cent. DDT wettable powder, 2 lb. of a 25 per cent. aldrin wettable powder, 1 lb. chlordane, 1·5 lb. of a 15 per cent. parathion wettable powder, or 3–4 pints of a 70 per cent. toxaphene cattle dip, all in 100 gals. water per acre. A BHC cattle dip diluted in water also proved effective.

Vestal (E. F.). **Control of Coconut Beetles and Weevils in Thailand.**—*FAO Plant Prot. Bull.* **5** no. 3 pp. 37–44, 9 figs. Rome, 1956.

Much damage is caused to coconut palms in Siam by *Oryctes rhinoceros* (L.), *Rhynchophorus ferrugineus* (Ol.) and *R. schach* (F.), the adults of all of which are briefly described. Coconut palms are present in all but the extreme north-west of the country, but most of them occur to the south of Bangkok. *O. rhinoceros* is widely distributed and attacks the bud, boring

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across the folded leaves, but is chiefly of importance because the wounds that it inflicts provide a means of entry for *Rhynchophorus*. It can be controlled by treatment of the heaps of compost and waste plant material in which it breeds. Infestation by *Rhynchophorus* is not yet so extensive as that by *Oryctes*, but is spreading slowly. *R. ferrugineus* is present in the central region, but not in the extreme south. Its eggs are laid on any part of the trunk or crown where wounds occur, but examination showed that infestation usually occurs at the base of the palm. The larvae bore in the palms, and injection of fumigants into infested parts gave poor results because the tunnels are so tightly packed with frass that gases cannot penetrate for more than a few inches. The only certain method of control is to fell the trees and burn the infested portions. Good protection from attack has been obtained on young palms by spraying them every three months with 0·1 per cent. dieldrin, which kills the ovipositing females. *R. schach* is present only in the extreme south and has doubtless spread from Malaya, where it is widely distributed. It was found almost exclusively in the tips of the palms and entered them in almost every case through wounds, principally those made by *Oryctes*. The leaves of infested palms become yellow and drop.

A demonstration of control methods was begun on an island, some 16 miles long and six miles wide, at the south-eastern border of Siam, on which the palms had been killed by *R. schach* over more than half the area. It was decided to clear all infested palms from a barrier strip about six miles long and one mile wide, to separate the uninfested from the infested area, and to prevent further spread, as the weevil appears unable to fly more than about a mile in one season. Some 3,000 palms, each containing from 6 to 148 adults and larvae of *R. schach*, were cut down and the infested portions burnt. As the sap attracts the adults, the stumps were sprayed with 0·1 per cent. dieldrin, and numerous dead examples were subsequently found round them. After the strip had been cleared, the felling of old dead palms in the uninfested area was begun, to prevent breeding by *Oryctes*. It was hoped that these measures would protect the remaining palms from attack, and new plantings were sprayed with dieldrin every three months.

Costantino (G.). *Citrus* **Bud Mite in Italy.**—*FAO Plant Prot. Bull.* **5** no. 3 pp. 45–46, 6 refs. Rome, 1956.

The author briefly reviews the literature on the deformation of *Citrus* fruits caused in California and southern Italy by *Aceria sheldoni* (Ewing) [*cf. R.A.E.*, A **42** 356, etc.] and experiments on the control of this mite in Sicily [**42** 356]. Lemon is the fruit chiefly affected in Italy, but infestation of bergamot (*Citrus bergamia*) in the Province of Reggio di Calabria has increased during the last five years and more than 5 per cent. of the fruits on some trees have been deformed and rendered useless for the extraction of essential oils, for which they are cultivated.

Cuscianna (N.). **Evoluzione dei sistemi e dei mezzi per la lotta contro la formica argentina** (*Iridomyrmex humilis* **Mayr**). **Parte II.** [The Development of Systems and Methods for the Control of the Argentine Ant (*I. humilis*). Part II.]—*Ann. Sper. agr.* (N.S.) **10** no. 4 suppl. pp. xxxiii–lxiii, 12 refs. Rome, 1956. (With a Summary in English.)

In this second part of a series, detailed accounts are given of further campaigns and experiments with sprays applied to the soil for the control

of *Iridomyrmex humilis* (Mayr) near Sanremo [*cf. R.A.E.*, A **44** 365] carried out in 1951–54. From the results and those of earlier years, the insecticides recommended are chlordane, dieldrin, aldrin and heptachlor, and information is given on the rates at which various proprietary preparations of these should be applied. The repeated applications necessary with DDT increase the cost of treatment. The toxicity of all these insecticides is briefly discussed, and results obtained with them in other parts of Italy against *I. humilis* are reviewed. Treatment should be begun in late spring or early summer, when the ants resume their activity and are most likely to come into contact with sprayed soil. Directions are given for the carrying out of spraying, and the cost of the various treatments is discussed.

DI MARTINO (E.). **Contributo alla conoscenza biologica dell'***Empoasca decedens* **Paoli e la fetola da essa prodotta nei frutti di agrumi in Sicilia. Esperienze di lotta.** [A Contribution to Knowledge of the Bionomics of *E. decedens* and of the Injury produced by it on *Citrus* in Sicily. Experiments on Control.]—*Ann. Sper. agr.* (N.S.) **10** no. 5 pp. 1511–1552, 1 col. pl., 17 refs. Rome, 1956. (With a Summary in English.)

In Sicily, *Empoasca decedens* Paoli causes superficial injuries to the fruits of orange and mandarin orange that considerably reduce their commercial value [*cf. R.A.E.*, A **44** 80, etc.]. The author briefly reviews the distribution and numerous food-plants of this Cicadellid and the damage that it causes, and gives an account of observations on its bionomics and control carried out near Catania in 1952–53.

There were several generations a year, development lasting about 30 days in spring and autumn and 15 days in summer. During the spring and summer, the insect was observed developing on various wild and cultivated plants that were common near *Citrus* groves and provided shelter from the wind and sun. Cotton was heavily infested, as it remains green throughout the summer, and considerable loss in yield resulted from the attack on the leaves. In autumn, when cotton had died off, the adults migrated, largely assisted by the wind, to *Citrus*, on which they overwintered. They were found at first on the fruits, which they punctured repeatedly, but when the weather was cold and rainy, they sheltered among dense foliage, between two fruits or in *Oxalis cernua*, which forms an abundant ground cover in the groves. Adults confined with leaves in November, December, January and February survived for up to 9, 11, 13 and 14 days, respectively, on orange, 9, 9, 16 and 12 days on mandarin orange and 12, 16, 22 and 15 days on *O. cernua*. Adults confined without leaves, with or without access to water, lived for shorter periods, the absence of moisture greatly reducing survival. It is concluded that *E. decedens* feeds on foliage during the winter, but that this alone is insufficient for survival until spring. Maximum numbers were taken on *Citrus* in late November, and few remained by 5th March, even though the fruits had not yet been picked, the migration to young herbaceous plants having begun. Females formed an average of over 91 per cent. of the adults taken during the winter.

Experiments on control were carried out in an orange grove in which large numbers of fruits were injured by *Empoasca* each year. Sprays were applied once, between 28th October and 4th November, when infestation was beginning on the peripheral trees, and examinations were made at intervals of about a week for the presence of the insect. The untreated trees rapidly became infested, but complete protection was afforded for about a week by 1 per cent. barium polysulphide, for ten days by 0·025 per

cent. of a product containing 46·6 per cent. parathion, for 35 days by 1–3 per cent. lime, and throughout the winter by 0·25 per cent. DDT in wettable-powder spray or emulsified solution. Comparable results were given on mandarin orange by barium polysulphide, parathion and DDT. At the end of March, when the insects had left the trees, the orange fruits were examined for injury. The percentages not injured or showing one puncture only and (in brackets) those heavily attacked were about 25–89 (0·5–3·3) for lime, 36 (6·5) for barium polysulphide, 32 (7·3) for parathion, 93 (0·1) for wettable DDT and 93 (0·5) for DDT in the emulsion spray, as compared with 23–28 (11·5–18·8) for no treatment. Leaves were taken from the sprayed trees at weekly intervals and adults confined on them and observed for mortality. The results, which are given in detail in tables, showed that DDT caused complete kill within 12 hours one week after application and within 72 hours 63–121 days after it. Parathion remained toxic for 7 but not 11 days, and the other materials caused no mortality.

It is concluded that DDT should be used against *Empoasca*, and that the increased value of the crop would more than offset the cost of further measures that might become necessary if it led to increases in other insects.

Isaakidès (C. A.). **La lutte biologique contre la mouche des olives en Grèce.**—*Pragm. Akad. Athen.* **22** pt. 1 repr. 19 pp. Athens, 1955. (With a Summary in Greek.)

The author supports his view that *Dacus* [*oleae* (Gmel.)] on olive in Greece can be satisfactorily controlled by indigenous parasites if favourable conditions are created for them [*cf. R.A.E.*, A **44** 358], from observations in 1954 in several areas, chiefly in eastern Crete, where damage by *Dacus* was not heavy.

In one such area, the olives were growing among carob trees [*Ceratonia siliqua*], many of the pods of which were infested by *Eumarchalia gennadii* (Marchal). This Cecidomyiid was found to be parasitised by *Eupelmus urozonus* Dalm. [*cf.* **26** 71], which also attacks *D. oleae*, and thus conditions were provided in which populations of the parasite could increase. In autumn, when *Dacus* is no longer available, it attacked *Myopites limbardae* (Schin.) (and probably also other species of this genus), which causes galls on *Inula viscosa*, a herbaceous plant that grows to a height of about 2½ ft. In another area, where oil of low acidity had been produced for some 10–12 years, presumably because of reduced *Dacus* attack, *I. viscosa* and *I. graveolens* were found growing abundantly round the olive groves, as a result of soil amelioration caused by forest fires during the previous decade. *I. viscosa* was infested by *M. limbardae*, which was parasitised by *E. urozonus*. *Inula* and other wild plants were also very abundant in a third area, noted for the good quality of its oil, and infestation by *Dacus* was very light even on olives of a late-developing variety. It was much higher, however, in pockets within the area where there was no undergrowth to shelter parasites, and there was a large increase in infestation in the island of Euboea when the ground beneath the trees was cleared for the growing of cereal and leguminous crops.

The importance of the control afforded by parasites is indicated by records of 11, 71·6 and 58 per cent. parasitism in July, August and September 1952, respectively, and 69·7 and 20·84 per cent. in early September and late October 1954, in one area in Crete. The author urges that *Inula* and other undergrowth should be encouraged beneath or near the trees, and use of contact insecticides detrimental to the parasites avoided.

Franssen (C. J. H.). **De bestrijding van de tuinbonenkever,** *Bruchus rufimanus* **Boh., volgens de ontwikkeling van het gewas.** [The Control of *B. rufimanus* on Broad Beans, in Relation to the Development of the Plant.]—*Tijdschr. PlZiekt.* **61** pt. 2 pp. 52–55. Wageningen, 1955. (With a Summary in English.)

Observations on *Bruchus rufimanus* Boh. on broad beans [*Vicia faba*] in Holland showed that the adults begin to emerge about the time of harvest. If the period of drying in the field is long, most have already appeared by the time the crop is taken in, but if it is short, many emerge in the barns. A few adults overwinter in the seeds and do not appear until the following spring, but the majority do so in the open, chiefly in the soil. The overwintered adults make their way to young bean plants, and in 1954, when the spring was late, the movement was completed in little more than a day, in late May, at a temperature of about 26°C. [78·8°F.]. A period of feeding in spring was found to be necessary for the maturation of the eggs, the females feeding on the nectar and pollen of the bean plants. The periods required for egg-maturation were at least 12–18 days in 1954. The eggs are laid on the pods. Control is best directed against the adults feeding in spring before oviposition occurs, and the crop should be sprayed as soon as the petals of the lowest flowers begin to wither. It is preferable to spray at temperatures above 17°C. [62·6°F.] since the adults are not active at lower temperatures and remain hidden in the plants. However, even if the temperature does not rise above 17°C., the sprays should be applied not later than petal-fall. DDT and parathion are effective and should be applied at 1·8 and 0·36 lb., respectively, per acre. Parathion is preferable to DDT if *Aphis fabae* Scop. is also present. Care should be taken to reach the lower parts of the plants with the sprays and one application is probably sufficient in the absence of any neighbouring source of infestation.

Evenhuis (H. H.). **Over de Cicadellidenfauna van de kers.** [On the Cicadellids of Cherry.]—*Tijdschr. PlZiekt.* **61** pt. 2 pp. 56–59, 10 refs. Wageningen, 1955. (With a Summary in English.)

Since it was thought that the virus that causes Eckelrade disease of sweet cherry in Holland might be transmitted by leafhoppers [*cf. R.A.E.*, A **43** 82], the Cicadellids present on cherry there were investigated. Those that bred regularly on the trees were found to comprise mainly *Typhlocyba quercus* (F.), *Erythroneura alneti* (Dhlb.), *E. flammigera* (Geoffr.), *Empoasca flavescens* (F.) and *Eupteroidea* (*Cicadella*) *stellulata* (Burm.), and notes are given on their bionomics. These species belong to a group not known to include vectors of any virus. Since the disease spreads slowly, vectors are more likely to be found among species that feed but do not reproduce on cherry, and several such were observed.

Meltzer (J.). **Morphological Notes on** *Bryobia* **Forms of Fruit Trees and Ivy.**—*Ent. Ber.* **15** no. 16 pp. 337–339, 2 figs., 2 refs. Amsterdam, 1955.

Morphological characters are given differentiating two forms of *Bryobia praetiosa* Koch found in Holland, one on apple and pear and the other on ivy [*Hedera helix*]; the fruit-tree form was also observed on *Crataegus*. Transfer experiments in 1954 failed owing to unfavourable weather, but the author considers that the fruit-tree form cannot maintain itself on ivy or

gooseberry or the ivy form on fruit trees or gooseberry [*cf. R.A.E.*, A **44** 438, etc.]. They are thought to represent distinct species [*cf.* next abstract].

VAN EYNDHOVEN (G. L.). *Bryobia* **from** *Hedera*, **Apple and Pear (Acar., Tetran.). Notulae ad Tetranychidas 1.**—*Ent. Ber.* **15** no. 16 pp. 340–347, 6 figs., 15 refs. Amsterdam, 1955. **Moderne inzichten in de systematiek van het genus** *Bryobia* **(Acar.). Notulae ad Tetranychidas 2.** [Modern Views on the Systematics of the Genus *Bryobia*.] —*Op. cit.* **16** no. 2 pp. 20–21. 1956. (With a Summary in English.) *Bryobia cristata* **(Dugès 1834) and** *Bryobia rubrioculus* **(Scheuten 1857) (Acar.). (Notulae ad Tetranychidas 3.)**—*T. c.* no. 3 pp. 45–46, 4 refs.

In the first of these papers, it is pointed out that the name *Bryobia praetiosa* Koch has been applied to a complex of mites differing in bionomics and food-plants but very similar morphologically [*cf. R.A.E.*, A **44** 438, etc.]. Koch's original specimens are not available, so that the identity of the true *B. praetiosa* is not certain. It was described as occurring, sometimes on bushes in gardens, at Regensburg, and probably differs from other forms for which the name has since been used, though it might possibly occur on gooseberry. The three forms of economic importance commonly attributed to it are those that occur on ivy (*Hedera helix*), apple and pear, and gooseberry, and from a comparison of material from various parts of Holland and other European countries the author considers that they can be distinguished morphologically, and gives characters differentiating the form on apple and pear and that on ivy, for which the name *B. kissophila*, sp. n., is proposed and which is recorded from Holland, France and Switzerland. These forms do not have males.

In the second paper, it is stated from further examination of material that the forms of *B. praetiosa* that occur on gooseberry, fruit trees and grass also represent distinct species. In the third, *B. cristata* Dugès, a name originally proposed for mites of both sexes living under stones and bark and feeding on grass in Paris and females on plum in southern France, is restricted to the form from Paris, and the name *B. rubrioculus* (Scheuten), which was originally given to a mite from pear at Bonn, is applied to the common species on apple and pear in western Europe, although it may not be the only one to occur on these or other fruit trees.

VAN DINTHER (J. B. M.). **Three noxious Hornworms in Suriname.**—*Ent. Ber.* **16** nos. 1–3 pp. 7–9, 26–28, 42–44, 3 figs., 3 refs. Amsterdam, 1956.

Descriptions are given of all stages of the Sphingids, *Protoparce sexta paphus* (Cram.), *Erinnyis alope* (Dru.) and *Pseudosphinx tetrio* (L.), which are of importance in Dutch Guiana. *Protoparce* infests tomato, peppers [*Capsicum*] and tobacco throughout the year and sometimes destroys the plants. The egg, larval and pupal stages last about 5, 10–14 and 14–19 days, respectively, and the eggs are often heavily parasitised by *Telenomus connectans* Ashm. *E. alope* is a minor pest of papaya and sometimes kills seedlings. The egg, larval and pupal stages last about 5, 16–17 and 14–15 days, respectively, and the eggs are often parasitised to a high degree by a species of *Telenomus* tentatively identified as *T. dilophonotae* Cam., 8–14 larvae of which develop in a single egg. *Pseudosphinx tetrio* is injurious to two ornamental trees, *Plumeria alba* and *P. rubra*, in the coastal region, and repeated defoliation sometimes kills them. The eggs are laid in masses

of up to 69 on the leaves, and the larval and pupal stages last 18–22 and 18–19 days each.

Bergman (B. H. H.). **On three Jassidae of** *Arachis hypogaca* **in Java.**—*Ent. Ber.* **16** no. 4 pp. 64–71, 5 figs., 3 refs. Amsterdam, 1956.

Empoasca sundaica, sp. n., is described from adults of both sexes and the genitalia, and the original descriptions of *Erythroneura tripunctula* (Melich.) and *Orosius argentatus* (Evans) are cited. All three Cicadellids were found injuring groundnuts near Bogor, West Java, in 1953–54.

van Dinther (J. B. M.). **Soybean Insects.**—*Ent. Ber.* **16** no. 6 pp. 104–109, 4 figs., 1 ref. Amsterdam, 1956.

Observations in 1953–55 showed that the major insect pests of soy beans in Dutch Guiana are *Laphygma frugiperda* (J.E.Smith), *Anticarsia gemmatalis* Hb., *Agrotis repleta* Wlk. and *Scapteriscus didactylus* (Latr.). The larvae of the Lepidoptera are described, and their alternative food-plants are noted. *Scapteriscus* tunnels just beneath the soil surface and feeds on the young stems, which are sometimes completely cut off. It also damages other crops. The pests of minor importance are *Cerotoma varicgata* (F.), a species of *Diabrotica*, probably *capitata* (F.), and a species of *Tetranychus* thought to be *T. telarius* (L.) (*bimaculatus* Harvey). The adults of the Coleoptera, which are described, feed on the leaves. A generation of the mite is completed in about ten days, and increase is rapid in dry weather, so that the plants are sometimes killed. A list is appended of a few insects of no apparent importance found on the plants.

van Dinther (J. B. M.). **Caterpillars injurious to** *Brassica* **Species in Suriname.**—*Ent. Ber.* **16** no. 10 pp. 201–206, 4 figs. Amsterdam, 1956.

Observations in Dutch Guiana in 1953–55 showed that *Laphygma frugiperda* (J.E.Smith), *Agrotis repleta* Wlk. and *Argyrogramma verruca* (F.) attack varieties of cabbage there, the first two regularly, *Symphysa amoenalis* (Wlk.) attacks Chinese cabbage (*Brassica chinensis*), and *Hellula phidilealis* Wlk. and *Ascia monuste* (L.) attack both. It is thought that all cultivated species of *Brassica* may be infested by any of them. The larvae of all of them and other stages of some are described. The pupal stage of *Symphysa* lasts 6–8 days, and complete development from egg to adult probably about a month. The pupal stages of *Hellula*, *Ascia* and *Argyrogramma* last 6–8, 5–6 and about 6 days, respectively.

Marín Hernandez (C.). **Biología y experimentación en el control del gusano rosado de las cápsulas del algodón,** *Sacadodes pyralis* **Dyar.** [The Bionomics of *S. pyralis* on Cotton and Experiments on Control.]—*Rev. Fac. nac. Agron.* **18** no. 49 pp. 1–29, 32–47, 10 figs., 37 refs. Medellín, 1956.

Sacadodes pyralis Dyar is a serious pest of cotton throughout much of Colombia. Losses average about 20 per cent. of the crop but rose to about 30 per cent. in Armero in 1949 and 1950, and whole crops are sometimes destroyed. All stages of the moth are briefly described, and the literature on its control is reviewed [*cf. R.A.E.*, A **26** 403]. Observations showed that the egg, larval, prepupal and pupal stages lasted 4–5, 14–16, 3–4 and

14–30 days, respectively. The adults survived for 4–9 days, and the females deposited some 250–300 eggs each. The eggs were mostly laid on the bracts at the base of the squares or bolls, but were also frequent on the stalks and in leaf axils. More than 200 eggs per plant were counted during a very heavy infestation, singly or in groups of up to 28. The larvae feed in the bolls and squares. Of over 100 varieties of cotton examined, none showed any resistance to attack.

The cultural methods of control recommended are the collection and destruction of infested squares as soon as these are observed, ploughing after picking, to expose the pupae, rotation of crops, and the removal of all débris from the fields. Light-traps attract the adults, but not in sufficient numbers to protect the crop from infestation.

Experiments on control by means of insecticides were carried out in 1949–52 in the Department of Tolima, in the west. Sprays and dusts were applied 5–6 times, and the best increases in yield of seed cotton were given by sprays of 0·5–1 per cent. lead arsenate, a 1:1 dust mixture of calcium arsenate and sulphur, a dust containing 20 per cent. toxaphene, a proprietary dieldrin spray, and a spray prepared from a product containing nicotine, DDT and trimethylnaphthalenes. The arsenical treatments are recommended, as being the least costly. The commonest natural enemy observed was *Polistes canadensis* (L.), which entered the bolls to reach the larvae; the latter were also attacked by *P. versicolor* var. *vulgaris* Beq., which was less abundant.

Cabal Concha (A.). **Biología y control del gorgojo del café: *Araecerus fasciculatus* de Geer, Fam: (Anthribiidae), en Barranquilla—Colombia.** [The Bionomics and Control of *A. fasciculatus* at Barranquilla, Colombia.]—*Rev. Fac. nac. Agron.* **18** no. 49 pp. 30–31, 49–72, 3 figs., 22 refs. Medellín, 1956.

Araecerus fasciculatus (Deg.) is virtually the only pest of stored coffee in Colombia and caused considerable damage to stocks awaiting export in 1942–43. All stages of this Anthribid are described, and its distribution and range of foods are reviewed. In the laboratory, it was successfully reared on a variety of flour products, including ground cacao and maize flour. Pairing occurred 4–5 days after emergence, and the females oviposited almost immediately, usually inserting their eggs into the beans when on coffee. Unfertilised females also oviposited, but scattered their eggs, which were rapidly devoured by the females that had laid them or by the males. The numbers of eggs laid per female (on a product containing ground green coffee and chocolate) averaged 52, the oviposition rate averaging three per day. Females were more abundant than males, comprising 55–74 per cent. of the population. The eggs hatched in 5–7 days, and the larval stage lasted 46–66 days at 28°C. [82·4°F.] and about 80 per cent. relative humidity. The prepupal and pupal stages lasted 1–1·5 and 5–8 days, respectively.

Infestation was heaviest on coffee of poor commercial quality, in which the beans were softer and more easily penetrated, but it was also heavy on coffee of high quality that had been stored for more than two years, as the beans then softened somewhat. In older coffee, in which the beans hardened again, infestation was considerably reduced. When males and females were confined for seven days with best-quality coffee that had been stored for 1, 2·5 or 3 years, the percentages of beans attacked were 49, 87 and 31, respectively.

The larvae of *Araecerus* were parasitised by *Anisopteromalus* (*Aplastomorpha*) *calandrae* (How.), *Cephalonomia gallicola* (Ashm.) and an undescribed species of *Plastanoxus*. Two mites, *Cheyletus* sp. and *Monieziella*

sp., attacked the eggs and afforded considerable control. The egg, larval, prepupal and pupal stages of *Anisoptcromalus* lasted about 1–2, 5–6, 1 and 6–7 days, respectively, and 2–3 generations could thus develop during the larval stage of the host. The egg, larval, prepupal and pupal stages of *Cephalonomia* lasted 2–3, 3–4, 4–5 and 10–12 days, respectively. Only small numbers of *Plastanoxus* were found. Females of the two mites laid about 25 eggs each. These hatched in 3–7 days, and there was one larval instar of 6–9 days and two nymphal instars of 4–6 and 7–10 days, respectively. The adults survived for some 20 days.

An account is given of the control measures carried out in 1942–43, which consisted in cleaning out infested warehouses and fumigating the bags of coffee with hydrogen cyanide or carbon bisulphide, both of which gave good results.

Sabrosky (C. W.). **The taxonomic Status of the Armyworm Parasite known as *Archytas piliventris* (van der Wulp) (Diptera: Larvaevoridae).**—*Florida Ent.* **38** no. 2 pp. 77–83, 6 figs. Gainesville, Fla., 1955.

The author shows that two species with distinct geographical ranges have been confused under the name *Archytas piliventris* (Wulp). One of them is *A. marmoratus* (Tns.), the range of which extends from the southern United States [*cf. R.A.E.*, A **31** 342] and the West Indies [**32** 23] to northern South America and southward down the west coast to northern Chile, and *A. incertus* (Macq.), of which the true *piliventris* is a synonym and which occurs in northern Argentina, Uruguay, Paraguay and southern Brazil. Characters differentiating the two species are noted, and their generic position is briefly discussed. These Tachinids are parasites of cutworms and similar Lepidopterous larvae, and *A. incertus* was introduced in small numbers from Argentina and Uruguay into the southern United States soon after 1940 against *Laphygma frugiperda* (J. E. Smith). It is not known whether it became established.

Cockerham (K. L.), Deen (O. T.), Christian (M. B.) & Newsom (L. D.). **The Biology of the Sweet Potato Weevil.**—*Tech. Bull. La agric. Exp. Sta.* no. 483, 30 pp., 6 figs., 14 refs. [Baton Rouge, La.] 1954.

The following is based on the authors' summary. *Cylas formicarius elegantulus* (Summers), all stages of which are described, is the most destructive insect pest of sweet potatoes in the United States. It is mainly confined to the coastal sections of Florida, Georgia, Alabama, Mississippi, Louisiana and Texas, and studies on its bionomics were made in 1937–49 in Louisiana [*cf. R.A.E.*, A **32** 234] to obtain information on factors affecting its survival and methods of preventing its spread. These showed that the duration of the egg stage ranged from four days in summer to 56 days in winter. The average number of eggs laid per female was 119. The larval stage ranged from 12 to 154 days and the pupal stage from five to 49 days, depending on temperature, and the adults survived for averages of 72 days for males and 85 days for females.

The adults pair soon after they emerge, and the females oviposit almost immediately. The eggs are laid singly in specially prepared cells in the roots and vines of the plants. Reproduction and activity continue throughout the year in Louisiana, although both are greatly reduced during the winter, and there are 6–8 generations a year, all stages being found at any time. Although most individuals pass the winter in the immature stages, a few adults overwinter in and round sweet-potato fields, even when food

is absent. The weevil was observed to reproduce only on plants of the genus *Ipomoca* [*cf.* **32** 55], although it fed on others. It is spread largely by transport of infested plant material, but the adults were found to fly freely and were taken in light-traps 1¼ miles from a point of liberation.

Natural enemies [*cf.* **33** 216] were of little importance in checking infestation; the fungus, *Beauveria globulifera*, kills many adults at times, but is not considered of much economic importance, as it does not develop under dry conditions. The most effective control measures have been the use of uninfested planting material, rotation of crops, the cleaning up of storage sites and old fields, and the destruction of infested sweet potatoes and wild food-plants.

MICHELBACHER (A. E.). **Frosted Scale on Walnuts in northern California (Hemiptera: Homoptera).**—*Pan-Pacif. Ent.* **31** no. 3 pp. 139–148. 2 figs., 6 refs. San Francisco, Cal., 1955.

The following is based on the author's summary. *Eulecanium* (*Lecanium*) *pruinosum* (Coq.) was seldom injurious to walnut in northern California until the advent of the newer insecticides. It is attacked by several parasites, of which the most important is *Metaphycus californicus* (How.), and these tend to restrict the scale to a non-economic level. Control is favoured by the fact that *E. pruinosum* has only one generation a year, whereas *M. californicus* has several.

When high dosages of DDT are used in sprays against the codling moth [*Cydia pomonella* (L.)] on walnut, serious infestation by *E. pruinosum* frequently develops [*cf. R.A.E.*, A **41** 138, 204]. Investigations showed that destructive populations are not likely to occur if DDT is applied at not more than 4 lb. per acre, and this quantity is sufficient to give adequate control of *C. pomonella* if the application is timely and thorough. The spray against *C. pomonella* is usually applied between the end of April and 20th May, when most of the parasites are developing within the scales and are thus protected from direct contact with it. Emergence of the parasites in numbers does not occur until after mid-June, and the residues from low dosages of DDT have by that time largely lost their toxicity to the adults, though high dosages are still toxic. Where serious infestation by *E. pruinosum* develops, parasites will in time reduce it to a non-destructive level if practices unfavourable to them are discontinued. The time required is usually about a season.

BURKHARDT (C. C.). **Preliminary Studies on Control of White Grubs in Wheat.**—*J. Kans. ent. Soc.* **28** no. 2 pp. 60–63, 2 figs. Manhattan, Kans., 1955.

Considerable resowing of wheat was necessary in Kansas in the autumn of 1953 owing to attack by larvae of *Cyclocephala* spp., and to a lesser extent of *Lachnosterna* (*Phyllophaga*) spp. Averages of 6–16 larvae per sq. ft., with a maximum of 37, were observed in some fields, the densest populations occurring in areas where heavy straw mulches had been ploughed in. In a test on control, dieldrin and heptachlor in wettable powders were mixed with the seed and applied through the drill box at sowing, on 19th September, at the rate of 2 lb. toxicant per acre. On 28th September, 10·2 and 9·2 per cent. of the larvae in the plots treated with dieldrin and heptachlor, respectively, were dead, as compared with 0·8 per cent. for no treatment. It is thought that these rather poor results may have been due in part to the downward migration of the larvae and a decrease in activity resulting from

low temperatures. Examination on 27th November showed an average reduction in stand of 73 per cent. in untreated plots, with a maximum of 91–97·3 per cent. in heavily infested spots, as compared with the plots treated with dieldrin or heptachlor. Plants in the latter averaged 5–6 ins. in height, and those in the control plots 3·5–4·5 ins.

Connin (R. V.). **The Host Range of the Wheat Curl Mite, Vector of Wheat Streak-Mosaic.**—*J. econ. Ent.* **49** no. 1 pp. 1–4, 7 refs. Menasha, Wis., 1956.

The following is substantially the author's summary of this account of investigations on the food-plant range of *Aceria tulipae* (Keifer), the vector of streak mosaic of wheat [*cf. R.A.E.*, A **44** 417, etc.], carried out in the greenhouse at Manhattan, Kansas, in the winter of 1953–54. The mite reproduced on 12 of 24 species of wild grasses and on all the varieties of wheat, barley, oats, sorghum and maize tested. The degree to which the population increased varied considerably, and wheat and barley appeared to be the best food-plants. The mosaic virus was transmitted by the mite from wheat to wheat, barley and oats and to the wild grasses susceptible to it.

Polivka (J. B.). **Effectiveness of Milky Disease in controlling Japanese Beetle in Ohio.**—*J. econ. Ent.* **49** no. 1 pp. 4–6, 5 refs. Menasha, Wis., 1956.

Various quantities of dust containing spores of *Bacillus popilliae* were applied to the soil for the control of larvae of the Japanese beetle [*Popillia japonica* Newm.] in 12 counties of Ohio in 1941–49. Surveys in eight of these each year from 1944 to 1954 showed a marked fluctuation in the percentage of larvae infected from month to month, from year to year and from locality to locality, but there was a marked decrease in larval populations from August to the following spring in affected areas. Surveys in Washington county, in which spores were not distributed, showed a high incidence of the disease from 1949 onwards. It was first observed over a small area at a distance of 70 miles from the nearest distribution point, had spread up to five miles by 1951 and was found in all areas with an average of more than five larvae per sq. ft. by 1954. It is not known how it reached this county, but it may have been carried by birds [*cf. R.A.E.*, A **30** 122], and its appearance indicates that the organism need not be distributed in all newly infested sites.

Vanderzant (E. S.) & Reiser (R.). **Aseptic Rearing of the Pink Bollworm on synthetic Media.**—*J. econ. Ent.* **49** no. 1 pp. 7–10, 23 refs. Menasha, Wis., 1956.

The following is based on the authors' summary. Techniques are described for rearing the pink bollworm, *Platyedra* (*Pectinophora*) *gossypiella* (Saund.), on sterile synthetic media; many of the adults obtained deposited fertile eggs, and three generations were reared on media containing no plant extracts. The bollworm developed on a wide variety of dietary constituents; a diet rich in protein was found to produce small larvae that developed slowly, but changes in the proportions of carbohydrate and fat did not affect size or rate of growth, and changes in the protein, carbohydrate and fat content of the media did not affect the number of larvae that entered diapause.

Smith (E. H.), Grainger (M. M.) & Avens (A. W.). **Parathion, EPN, Dieldrin and Methoxychlor for Control of the Plum Curculio on Prunes.** —*J. econ. Ent.* **49** no. 1 pp. 14–18, 8 graphs, 3 refs. Menasha, Wis., 1956.

Factors contributing to the effectiveness of parathion, EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate *], dieldrin and methoxy-DDT (methoxychlor) for the control of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] were investigated in field experiments on prune and in laboratory tests in New York in 1949–54.

In a schedule of sprays recommended to growers to prevent invasion of the trees by overwintered adults, comprising three treatments in May or June in 1949–51 and one each in late May and early June in 1952–54, parathion, applied in all years, and EPN, dieldrin and methoxy-DDT, applied in 2–3, resulted in about 90 per cent. or more reduction in larvae leaving the fruits, except in 1953; in that year, unseasonably cold weather prevented insect activity until several days after the second spray application, when residues of parathion, EPN and methoxy-DDT had apparently fallen below the effective level, though dieldrin still gave 99·2 per cent. reduction. Seasonal variations in effectiveness were greatest for parathion and least for dieldrin, and it is concluded that dieldrin was the most effective material, followed in order by EPN, methoxy-DDT and parathion.

Sprays directed against eggs, larvae and adults were also tested, because treatments sometimes have to be delayed until some injury has occurred. The results varied according to the stages of the insect present at the time of application, but the relative performance of the insecticides was fairly constant. In 1953, a single application was made on 11th June, when about 15 per cent. of the eggs laid had hatched and considerable injury had occurred. Parathion was the most effective, followed by dieldrin, EPN and methoxy-DDT, but all gave more than 50 per cent. reduction in larvae leaving the fruits; those not killed by dieldrin were apparently larvae that had hatched, somewhat prematurely, before treatment. In an earlier test, all materials had some ovicidal action; the lethal effect was greatest and occurred earliest in embryonic development for parathion, followed by EPN.

A test in which trees were sprayed on 15th June and the residues on the leaves determined at intervals showed a rather close relation between spray concentration and initial deposits of parathion, EPN and dieldrin, whereas methoxy-DDT gave a relatively heavier deposit. Parathion weathered the most rapidly, only 1 per cent. of the original deposit being left after 14 days, and methoxy-DDT the most slowly, with 20 per cent. left after 14 days. Branches bearing fruits were cut from the sprayed trees at intervals and caged with laboratory-reared adults, and the results showed that toxicity was well maintained for four days; the minimum effective residues of parathion, EPN, dieldrin and methoxy-DDT were calculated to be 34, 68, 71 and 865 mg. per 100 sq. cm.; the phosphorus compounds acted more rapidly than the chlorinated insecticides. Laboratory tests of contact toxicity, in which adults were wetted with water suspensions of the insecticides, showed the median lethal concentrations to be 14, 32, 104 and 4,000 parts per million, respectively, which suggests that the effectiveness of methoxy-DDT in the field is due not only to contact action but also to stomach toxicity and possibly to repellency, and furthermore that contact toxicity is closely related to residual toxicity for the phosphorus insecticides,

* This compound, previously cited as ethyl p-nitrophenyl thionobenzenephosphonate, is named in accordance with the rules already noticed [*R.A.E.*, A **43** 69, note] for the nomenclature of compounds containing one phosphorus atom. It is now proposed to adopt the rules for such compounds in this *Review*.—*Ed.*

but is not a reliable index to the effectiveness of chlorinated hydrocarbons, which may have a different mode of entry.

Barnes (D.) & Hodson (A. C.). **Low Temperature Tolerance of the European Corn Borer in Relation to Winter Survival in Minnesota.** —*J. econ. Ent.* **49** no. 1 pp. 19–24, 3 graphs, 8 refs. Menasha, Wis., 1956.

The European corn borer [*Pyrausta nubilalis* (Hb.)] spread rapidly northward into all the maize-producing areas of Minnesota. The hibernating larvae usually survive the winter well there, even in maize stems above the snow, but mortality was high in the winter of 1947–48, when many larvae in instars earlier than the fifth entered hibernation. The susceptibility of the larvae to cold was therefore investigated by undercooling them at −32°C. [−25·6°F.].

Second-generation larvae in the fourth instar, collected in the field in autumn in 1948 and 1949, were found to have average undercooling points of about −10·7°C. [12·74°F.] [*cf. R.A.E.*, A **31** 17]; in both years, they all froze hard after undercooling and died, and it is concluded that immature larvae are not resistant to cold and that there is a correlation between the age composition of the autumn population and ability to overwinter successfully. The average undercooling points of fifth-instar larvae fell gradually in 1949 from −14·6°C. [5·72°F.] on 31st July and −11·5°C. [11·3°F.] on 17th August to −22°C. [−7·6°F.] on 23rd October; their water content fell likewise from 63·5 to 52·7 per cent., and none of the larvae survived freezing until the last date was reached, when only one of seven larvae was killed by it. To determine whether fourth- and early fifth-instar larvae would tolerate prolonged exposure to low temperatures above the undercooling point, they were kept at 5°C. [41°F.] in contact with saturated blotting paper: 94 per cent. of the fourth-instar larvae died within a week, and 18 and 26 per cent. of the fifth-instar examples died within one and two weeks, respectively, so that considerable mortality of such stages in late autumn may be expected.

Larvae collected from maize stalks during winter and early spring were found to comprise some that were frozen hard and surrounded by ice crystals and some that were soft and free from ice; both frequently occurred in the same stalk. The undercooling points of hard and soft larvae collected in early February 1949 averaged −29° and −28·6°C. [−20·2° and −19·48°F.], respectively, and all larvae survived treatment, even though cooled again to the undercooling point after the rebound had occurred. It is thought that the soft larvae were in the undercooled but unfrozen state and that the larvae frozen hard had been cooled below the undercooling point. The undercooling point of field-collected larvae remained at about −29°C. until the end of March and then rose very slowly but it was still −20·4°C. [−4·72°F.] on 7th May, when the danger of frosts was past. All larvae survived the treatment, indicating that cold-hardiness was at its maximum, and there was little difference in response between larvae from the south and the north of the State. The undercooling point did not decrease again until after reaching its peak in August, but freezing following undercooling was not tolerated until after mid-October. It thus appears that about −20°C. [−4°F.] is the critical undercooling temperature, above which the larvae are unable to withstand freezing.

Further laboratory tests indicated that the combined effects of moisture and a high temperature (10–20°C. [50–68°F.]) were necessary for a rapid and significant rise in the undercooling point of cold-hardy larvae. Examples in contact with free moisture at 20°C. showed a rise in the undercooling

point of some 11°C. [19·8°F.], about half of which occurred in the first 2–3 days. The rise at 10°C. was much less, and none of the various larvae in which the undercooling point had been raised survived freezing after undercooling. In the absence of free moisture, the rise at high temperatures was much reduced. Measurements showed that there is sufficient moisture in apparently dry maize stalks in spring for the process to occur, but spring mortality from freezing is unlikely because the temperature does not rise sufficiently to raise the undercooling point until the danger of frost is past. Dry storage at −32°C. for 18–22 days had no effect on cold-hardy larvae with an undercooling point of −27·6°C. [−17·68°F.], but storage in contact with free moisture was fatal within a week. The larvae also failed to survive repeated undercooling and thawing, but this is not likely to occur to any extent in the field, even in spring, and it is concluded that field mortality during autumn must be greater than that in winter or spring.

Boush (G. M.), Starks (K. J.) & Thurston (R.). **Control of the Green Peach Aphid on Burley Tobacco.**—*J. econ. Ent.* **49** no. 1 pp. 24–27. 4 refs. Menasha, Wis., 1956.

The results are given of preliminary laboratory and field tests of insecticides for the control of *Myzus persicae* (Sulz.) on tobacco in central Kentucky. In the laboratory, emulsion sprays of parathion and Chlorthion [O,O dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] at 50 parts per million, malathion at 200 p.p.m. and lindane [almost pure γ BHC] and endrin at 400 p.p.m., resulted in 97–100 and 90–99 per cent. fewer Aphids on treated than on untreated plants after two and seven days, respectively. and four systemic insecticides, Am. Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate], Am. Cyanamid 3911 [O,O-diethyl S-ethylthiomethyl phosphorodithioate], Shell OS-2046 [dimethyl 2-ethoxycarbonyl-1-methylvinyl phosphate] and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] at 50 p.p.m. resulted in 96–99 and 76–94 per cent. fewer. Bayer 17147 [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] was also effective at 50 p.p.m., but less so than the other systemic compounds. Shell OS-2046 and Am. Cyanamid 12008 appeared to give the quickest initial kill, and the former was as effective at 25 as at 50 p.p.m. in an unreplicated test. Nicotine sulphate, DDT and Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] at 50 p.p.m. gave 20–40 per cent. reduction in a preliminary laboratory test and were not investigated further.

In field tests of dusts applied at 30–40 lb. per acre, parathion and Chlorthion at 1 per cent. resulted in about 97 per cent. fewer Aphids after 48 hours than no treatment, and 4 per cent. malathion and 1 per cent. γ BHC or endrin in 87·2, 67·2 and 77 per cent. fewer, respectively.

Baker (V. H.), Wiant (D. E.) & Taboada (O.). **Some Effects of Microwaves on certain Insects which infest Wheat and Flour.**—*J. econ. Ent.* **49** no. 1 pp. 33–37, 1 fig., 8 refs. Menasha, Wis., 1956.

Investigations on the effect of irradiation with electromagnetic microwaves of a wavelength of 12·25 cm. on *Tribolium confusum* Duv. and *Calandra* (*Sitophilus*) *granaria* (L.) were made as part of an examination of the effect of radiant energy on biological tissues; it is emphasised that this effect is due solely to the heat generated as a result of the microwave energy absorbed by the tissues, and the apparatus used is briefly described.

Samples of 50 adults of *Tribolium* and *Calandra* in 75 gm. whole-wheat

flour and wheat, respectively, were kept for four days to allow time for oviposition, subjected to irradiation for up to 21 seconds and examined 1–7 days later. All adults of *Tribolium* died in one day when irradiated for 15 seconds to a maximum temperature of 165°F., and 23 and 2 per cent., respectively, of the eggs hatched after this treatment and after exposure for 21 seconds to a maximum of 178°F. Irradiation for 12 seconds to a maximum of 162° resulted in complete mortality of *Calandra* adults in a week and 2·5 per cent. hatch, and irradiation for 15 seconds to a temperature of 172°F. killed all the adults and entirely prevented hatching. When larvae of *T. confusum* in flour were treated, irradiation for 18 seconds to 187°F. resulted in complete mortality in 35 days.

The temperatures reached in irradiated wheat and flour indicated that they absorb microwave energy well, and since it was necessary to heat the total mass to a temperature lethal to the insects before all these were killed, there does not appear to be any selective heating action between the products and the insects infesting them.

Forgash (A. J.). **Differences in Arsenic Tolerance among the Sexes and various Stages of the American Cockroach.**—*J. econ. Ent.* **49** no. 1 pp. 39–43, 2 graphs, 7 refs. Menasha, Wis., 1956.

Since differences in tolerance to insecticides within species are probably due to morphological, biochemical or physiological variations between sexes and developmental stages, investigations on such variations in *Periplaneta americana* (L.) were made in an attempt to contribute to the understanding of the mechanisms of action of insecticides.

Solutions of arsenic trioxide were injected into the thoracic cavities of cockroaches that had been deprived of food and water for 24 hours and then immobilised with carbon dioxide, and the insects were weighed immediately and the dosages calculated from the quantities of arsenic injected and the body weights. Examination for mortality at intervals of 24 hours showed that adult males were much more susceptible than adult females, and that nymphs in the last instar were less susceptible than the adults, with no difference between the sexes. Determinations of the reduced glutathione (GSH) in the insects [*cf. R.A.E.*, A **40** 102] showed that it was present in approximately equal concentrations in adult males and females (1·3 mg. per gm. insect dry weight) and in slightly lower concentrations (1·11 and 1·26 mg. per gm.) in males and females in the last nymphal instar, so that differences in arsenic tolerance cannot be explained on the basis of gross differences in GSH. There appeared to be little difference in GSH concentration between nymphs at early and late stages in the last instar, though it is possible that it increases rapidly for a short time immediately before the moult, but newly emerged adults contained only about 66 per cent. as much as older ones.

Measurement of oxygen consumption showed that the respiratory rate of the adult females is considerably lower than that of the adult males and somewhat higher than that of the nymphs, which showed no difference between the sexes. There is thus a relation between susceptibility to arsenic trioxide and respiration rate [*cf.* **15** 183].

Tanada (Y.). **Some Factors affecting the Susceptibility of the Armyworm to Virus Infections.**—*J. econ. Ent.* **49** no. 1 pp. 52–57, 1 graph, 17 refs. Menasha, Wis., 1956.

The following is based on the author's introduction and summary. In the spring of 1954, an outbreak of armyworms destroyed range grasses over large

areas in the island of Hawaii. A localised population of one of these, *Pseudaletia unipuncta* (Haw.), was almost exterminated by a virus epizootic, most of the living larvae collected from the area dying from apparent polyhedrosis, but one with typical external symptoms of granulosis and many granules in its tissues. Although the larvae were highly susceptible to the polyhedrosis virus in the field, they were relatively resistant to it and also to the granulosis virus under laboratory conditions, and some of the factors that might affect susceptibility to the two were therefore investigated. The larvae were infected by feeding on leaves that had been dipped in virus suspensions.

It was found that resistance to infection increased directly with the age of the larvae, those in the first two instars being highly susceptible to both viruses and those in the last four much more resistant. The larvae appeared to be much more susceptible to the granulosis than to the polyhedrosis virus. Susceptibility was not affected by increasing the concentration of the suspension, by providing repeated doses over a period of 11–12 days, by feeding the larvae on *Pennisetum purpureum*, *P. clandestinum* or maize or by changing the food-plant from *P. purpureum* to *P. clandestinum* or maize or from maize to *P. purpureum*.

The most important factor found was the increased effectiveness of combinations of the two viruses; a mixture of the two supplied to larvae in the last four instars resulted in high mortality. The infected larvae showed typical symptoms of polyhedrosis and contained mainly polyhedra in the tissues after death, but some contained both polyhedra and granules, which indicated that multiple infection had occurred. This is apparently the first record of such a relation between two insect viruses, and it was probably one of the major factors responsible for the epizootic observed in the field.

Verma (J. S.). **Effects of Demeton and Schradan on** *Peregrinus maidis* **(Ashm.) and its Egg-predator,** *Cyrtorhinus mundulus* **(Breddin).**— *J. econ. Ent.* **49** no. 1 pp. 58–63, 3 figs., 12 refs. Menasha, Wis., 1956.

Since *Tytthus* (*Cyrtorhinus*) *mundulus* (Bredd.) has not proved very successful against *Peregrinus maidis* (Ashm.) on maize in Hawaii [*cf. R.A.E.*, A **44** 432], demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] and schradan were tested as supplementary means of control. Laboratory tests were made to determine the comparative toxicity of these insecticides to the two species and their systemic action when applied to seed, foliage and roots, and field tests to compare the effects of demeton and DDT on populations of the two.

When demeton and schradan were applied in sprays to anaesthetised insects in a spray tower, to test their contact effect, the median lethal concentrations were 0·044 and 0·58 mg. per ml., respectively, for *P. maidis* and 0·037 and 1·773 for *T. mundulus*. Soaking maize seeds in 0·1, 1 and 10 mg. demeton or 12·6, 31·5 and 63 mg. schradan per ml. for 18 hours before sowing resulted in plants that were toxic to *P. maidis*, but only the highest concentration of demeton proved very effective, giving complete kill for 12 days and remaining toxic for six weeks after sowing; it delayed germination but did not reduce the rate of plant growth, and both insecticides caused some leaf damage at the higher concentrations. Spraying half of each of a series of maize plants in pots with 40 ml. of a spray containing 0·1 or 1 mg. demeton per ml. resulted in practically uniform distribution in the plant within 24 hours, when the higher concentration gave complete kill of *P. maidis*, whereas the same amount of spray containing 13 mg. schradan per ml. required 11 days for complete translocation and gave about 85 per cent. control. Concentrations of 0·01 mg. demeton and 1·3 and 0·13 mg. schradan per ml. did not result in translocation of toxic amounts.

When applied to the roots of maize in 50 ml. irrigation water per plant, both insecticides were readily absorbed and translocated to all parts within 48 hours; 5 mg. demeton per plant caused 100 and 91 per cent. mortality of *P. maidis* after 2 and 7 days, respectively, but only 33 per cent. after 14 days, whereas 314 mg. schradan per plant afforded 73–100 per cent. kill for 40 days, being apparently less effective but more persistent. When *T. mundulus* was allowed to feed on the eggs of *P. maidis* in the midribs, doses of 25 and 12·5 mg. demeton per plant caused 100 and 80 per cent. mortality after one day and 10 and 25 per cent. after seven, whereas lower doses of demeton and doses up to 1,257 mg. schradan per plant resulted in little mortality of the predator. Further tests showed that the eggs of *P. maidis* were not poisoned and that demeton in the leaves had a fumigant action, whereas schradan did not; it is concluded that the insecticidal effect on *T. mundulus* was due to this. Demeton had no effect on *P. maidis* on a second sowing of maize three months after the soil treatment, but schradan caused some mortality and reduced the numbers of oviposition scars. Maize growing in soil treated with 500 mg. demeton per plant showed marked stunting and scorching of the tips and died within a month, and those growing in soil treated with 50 mg. demeton or 1,257 mg. schradan showed some leaf injury.

Field applications of 0·4 lb. demeton and 2 lb. 50 per cent. wettable DDT per 100 U.S. gals. spray caused 98 and 73 per cent. reduction in *P. maidis* in a week, followed by a gradual increase and a gradual decrease, respectively, for another fortnight, after which numbers rose on all plants. The numbers of the predator remained very low on plants sprayed with either insecticide, and it appeared, therefore, that treatment with demeton would not supplement the biological control of *Peregrinus*; it caused serious damage to the plants, of which only 12–15 per cent. produced normal ears.

Sivik (F. P.) & Kulash (W. M.). **Treated Cloth Bags to control the Rice Weevil in Corn.**—*J. econ. Ent.* **49** no. 1 pp. 64–65, 5 refs. Menasha, Wis., 1956.

In tests in North Carolina, heavy cotton bags, 18 ins. long and 7½ ins. wide, were sprayed on the inside with 10 ml. 1 per cent. emulsifiable aldrin, dieldrin, endrin, isodrin, BHC, lindane [almost pure γ BHC], malathion or Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of approximately 66 per cent.] or wettable parathion, allowed to dry, filled with 10 lb. untreated maize and stored from 1st May to 11th November 1954 at an average temperature of 79°F. and 81 per cent. relative humidity. The maize, which had been harvested in the previous autumn, had a moisture content of 13·75 per cent. and was infested by the rice weevil [*Calandra oryzae* (L.)], which had presumably spread to it in the field. Examination of the grain in these bags and of maize mixed with 10 gm. ryania or of a mixture of 10 per cent. piperonyl butoxide and 0·75 per cent. pyrethrins and stored in untreated bags showed the presence of living weevils in all bags one month after treatment, in grain treated with parathion, pyrethrum or Strobane three months after it, and in that treated with the last two six months after it, when the numbers had increased considerably.

Kulash (W. M.). **Further Laboratory Tests for Wireworm Control.**—*J. econ. Ent.* **49** no. 1 pp. 65–67, 2 refs. Menasha, Wis., 1956.

Further investigations on seed or soil treatment with insecticides for the protection of maize from attack by *Melanotus communis* (Gylh.) in North Carolina [*cf. R.A.E.*, A **43** 51, etc.] were made in the laboratory in 1953. The seed treatments were applied by stirring the seed in water containing

wettable powder or emulsion concentrate or dipping it into an adhesive and then rolling it in ground impregnated *Citrus* pulp and allowing it to dry before it was sown in cans, and the soil treatments by spraying or dusting before sowing. The soil was infested with wireworms and examined daily for eight days for insect activity, after which final observations were made on plant growth, injury and wireworm mortality.

Seed treatments with 5 per cent. aldrin, heptachlor or chlordane on *Citrus* pulp at the rate of 1·5 gm. per 100 gm. seed were the only ones that gave fair or good wireworm kill, and these and 1 gm. 14 per cent. wettable lindane [almost pure γ BHC] or 12·5 per cent. wettable dieldrin, both mixed with thiram [bis(dimethylthiocarbamoyl) disulphide], and 1·5 gm. 5 per cent. dieldrin on *Citrus* pulp per 100 gm. seed gave moderate or good protection from attack, whereas 1 gm. 18·5 per cent. emulsifiable endrin or wettable 2,4-dinitrofluorobenzene per 100 gm. did not. When all but the last were applied to the soil, 12·5 per cent. dieldrin at 4 lb. per acre gave the best kill, followed by 1 lb. 18·5 per cent. endrin, 5 lb. 5 per cent. heptachlor and 2 lb. ·14 per cent. γ BHC per acre, and all gave fair or good protection from attack, wettable dieldrin and 5 lb. 5 per cent. chlordane on *Citrus* pulp being the best. A dust containing 0·08 per cent. pyrethrins and 1·1 per cent. piperonyl butoxide, applied to both soil and seed in one test, was ineffective. The formulations on *Citrus* pulp had no effect on germination in sterilised soil, but reduced it on paper towels, owing to the growth of fungi on the pulp.

Arthur (B. W.) & Arant (F. S.). **Control of Soil Insects attacking Peanuts.** —*J. econ. Ent.* **49** no. 1 pp. 68–71, 6 refs. Menasha, Wis., 1956.

The following is substantially the authors' summary. Experiments in 1947–53 showed the larvae of *Diabrotica undecimpunctata howardi* Barber, *D. balteata* Lec., *Elasmopalpus lignosellus* (Zell.) and *Conoderus* sp. to be the principal insects causing subterranean damage to groundnuts in Alabama. The percentage damage to the pods (3·5–44·5 per cent. in the seven years) was much higher than that to the kernels, but many damaged pods were lost during harvesting operations.

Sprays of demeton [diethyl 2-(ethylthio)ethyl phosphorothioate], Metasystox [dimethyl 2-(ethylthio)ethyl phosphorothioate (methyl-demeton)], schradan or Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] applied to the foliage did not reduce damage to the pods, but 4–6 applications of dusts of 2·5 per cent. DDT or 10 per cent. toxaphene for the control of leaf-feeding insects reduced it to some extent. Dust applications of DDT, BHC, chlordane, toxaphene and aldrin in the drill before sowing reduced soil damage but did not increase the yield significantly; in one experiment, treatment with BHC significantly reduced it. Similar treatment with emulsions containing aldrin, dieldrin or heptachlor neither reduced the damage nor increased the yield in 1952.

In 1953, insect damage was reduced and the yield increased significantly where aldrin, dieldrin or toxaphene in granules was applied to the soil surface when the pods began to reach the soil. Aldrin and dieldrin used at 2 lb. per acre and toxaphene at 6 lb. resulted in gains of 289–442 lb. cured groundnuts per acre on sandy soil, but were less effective on clay soil.

Pfrimmer (T. R.) & Gaines (R. C.). **Field Tests with Insecticides against Cotton Insects at Tallulah, La., in 1954.**—*J. econ. Ent.* **49** no. 1 pp. 72–74. Menasha, Wis., 1956.

The results are given of five experiments carried out in Louisiana in 1954 with organic insecticides for the control of *Anthonomus grandis* Boh., *Heliothis zea* (Boddie), *Aphis gossypii* Glov., and two mites, *Tetranychus telarius*

(L.) and *T. desertorum* Banks, on cotton. *Anthonomus* was the most injurious of these, but was controlled to some extent by the weather; *Heliothis* was of little importance, particularly where drought prevailed, and infestation by the Aphid and the mites was very low, though the mites increased late in the season in some plots. The cotton was sown on 18th–22nd April, and satisfactory control of *Anthonomus* was given by seven applications between 16th July and 13th August of dusts containing 5 per cent. DDT with 1·5 per cent. dieldrin, alone or with 40 per cent. sulphur, 0·5 per cent. parathion or 2 per cent. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], 5 per cent. DDT with 2·5 per cent. heptachlor, 5 per cent. DDT with 2·5 per cent. heptachlor or aldrin and 40 per cent. sulphur, and 5 per cent. DDT with 3 per cent. γ BHC, alone or with 40 per cent. sulphur, 1 per cent. parathion or 2 per cent. Aramite, all at an average rate of 10–15 lb. per acre, and by a similar schedule of 10 per cent. DDT with 6 per cent. γ BHC at 8 lb. per acre, though this was just significantly less effective than the mixture of DDT, BHC and Aramite. All these dusts reduced injury by *Heliothis* (which was, however, very light), sulphur, parathion and Aramite reduced infestation by the mites, whereas DDT with heptachlor increased it, and there were no significant differences between yields. Dusts containing 5 per cent. DDT, 40 per cent. sulphur and 3 per cent. γ BHC from concentrates of different γ isomer content and one containing no sulphur, applied nine times at an average rate of 11–14 lb. per acre between 9th July and 20th August, gave significant control of *Anthonomus*, but less than was expected; two mixtures formulated from BHC containing 12–14 per cent. γ isomer were the most effective and one from BHC containing 35–40 per cent. γ isomer and one from lindane [almost pure γ BHC] the least effective. All but one mixture significantly reduced the Aphid infestation, and all mixtures containing sulphur reduced the mite population, but there was no significant control of *Heliothis*. All treatments increased the yield, with no differences between them.

In sprays applied ten times between 8th July and 25th August, 0·16 lb. dieldrin, 0·21 lb. endrin, a mixture of 0·1 lb. of each of these materials, and 0·28 lb. heptachlor per acre gave significant control of *Anthonomus*, whereas 0·25 lb. Am. Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate] and 0·29 lb. Am. Cyanamid 12009 [O,O-diethyl S-n-propylthiomethyl phosphorodithioate] did not and resulted in reduced yields. Endrin and the mixture gave good control and dieldrin, heptachlor and Am. Cyanamid 12008 some control of *Heliothis*, and the first three of these caused significant increases in yield. In dusts applied at average rates of 12–17 lb. per acre on nearly the same dates, 20 per cent. toxaphene with 40 per cent. sulphur, 2 per cent. endrin alone and with 40 per cent. sulphur and 20 per cent. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of approximately 66 per cent.] controlled *Anthonomus*, whereas 3 per cent. Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] did not, but this gave the best control of the Aphid and, with dusts containing sulphur, of the mites. Only Strobane resulted in an increase in Aphid infestation, and only endrin formulated with inert tobacco dust failed to reduce the mites. The plants dusted with endrin had least injury by *Heliothis*, but there were no significant effects on yield.

Thornton (D. G.) & Davis (J. M.). **A Method of Sampling for the Drop Size of Aerial Spray Deposits.**—*J. econ. Ent.* **49** no. 1 pp. 80–83, 1 ref. Menasha, Wis., 1956.

The following is the authors' summary. A method was devised for sampling drop records in determining the atomization of aerial spray deposits.

It requires the selection at random of a small number of mass median diameter determinations and computation of the mean mmd and error of this sample. In turn, each determination involves measuring drops on an area on each of a number of cards placed at regular intervals across the spray swath. Two methods of selecting drops for an mmd determination were used. In one, the constant area method, a single area was marked on each card and all drops within the area were measured. In the other, the variable area method, the size of the area was varied approximately as the cube of the drop diameter, so that large drops were sampled more intensively than small ones. With respect to time required for drop measuring and computation of a mean mmd with a 10 per cent. error, the variable area method proved superior in three out of four flights. Additional comparisons of the two methods will be continued in future studies of the atomization of aerial spray deposits.

Kerr (S. H.). **Chinch Bug Control on Lawns in Florida.**—*J. econ. Ent.* **49** no. 1 pp. 83–85, 9 refs. Menasha, Wis., 1956.

Lawns of *Stenotaphrum secundatum* in Florida are subject to severe damage by insects, chiefly *Blissus insularis* Barber, and experiments on the control of this Lygaeid were carried out in the summer of 1954. Grass plots in three representative localities were watered and then sprayed from a watering can with 5 U.S. gals. emulsion concentrate per 100 sq. ft., usually twice with an interval of 7–10 days, and insect counts were made from soil samples taken from treated and untreated plots about ten days after each application. Control was difficult in thick, lush turf. Chlordane at 10 lb. actual compound per acre was effective only on thin turf or against a light infestation, and 5 lb. dieldrin only on thin turf, whereas parathion at 1·5 lb. and DDT at 10 lb. per acre were satisfactory under all conditions. Demeton at 1 lb. per acre was ineffective, and Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of approximately 66 per cent.], which was tested only on extremely deep turf, gave less than 50 per cent. control at 4 lb. per acre. DDT showed considerable persistence on both thick and thin turf, and parathion did so on the former when it had soaked well down into it, but not on the latter. Single applications of DDT at 100 lb. and dieldrin at 25 lb. per acre were no better than 2–3 at 10 and 5 lb. per acre, respectively.

Isler (D. A.) & Yuill (J. S.). **Research on the Control of Forest Insects by Aircraft.**—*J. econ. Ent.* **49** no. 1 pp. 92–94, 6 refs. Menasha, Wis., 1956.

The authors review recent research carried out in the United States on the use of aeroplanes in the control of forest insects. Its main object has been to reduce the cost of applying insecticides, notably DDT, in sprays by improving the efficiency of spray equipment, spray formulations and the procedure of application. Single- and multiple-engined aircraft, fitted with a pump and underwing boom and nozzle systems, have been found the most satisfactory, as the pump ensures a uniform rate of output and the boom permits changes in arrangement and type of nozzles to suit particular requirements. For testing the effect of different degrees of spray atomisation under the same atmospheric conditions, a dual spray apparatus was constructed, consisting of two complete spray systems by which liquids of different colour could be applied simultaneously, the quantity deposited by each at any point in the spray swathe being determined with a spectrophotometer. The use of

this on an aeroplane flying upwind over open ground at an altitude of 50 ft., to compare a medium spray (150 μ mass median diameter) with a coarse one (300 μ) and a fine one (80 μ), showed that coarse atomisation resulted in the narrowest swathe, the least uniform distribution across the swathe and excessively high deposit peaks, and the fine one in a slightly wider and more uniform swathe than the medium spray, which advantage was, however, reduced by the greater loss of the fine spray, and it was concluded that medium atomisation produces the most efficient swathe pattern for forest spraying; this was confirmed by field tests in which medium spray atomisation proved the most effective against the spruce budworm [*Choristoneura fumiferana* (Clem.)].

Investigations on the improvement of deposit pattern by varying the position of the nozzles along the boom, carried out with a spray of 150 μ mmd from an aeroplane flying upwind at 80 miles per hour at an altitude of 50 ft., indicated that a concentration of nozzles under the outer half of the wing resulted in higher peaks of excess deposit, with no appreciable increase in swathe width, than the standard arrangement of nozzles along the full wing span, and that 24 nozzles concentrated under the inboard half of the wing or distributed along the full span resulted in almost identical spray patterns. Preliminary tests showed that the normal flying height may be increased without reducing the effectiveness of the application. Methods for marking the swathe or guiding the aeroplane in large-scale operations would greatly increase the effectiveness of aeroplane treatment.

Reference is also made to new types of aeroplanes, specially designed for agricultural purposes, and of simplified techniques for measuring the quantity and degree of atomisation of spray deposits [*cf. R.A.E.*, A **45** 99], which should facilitate further research; the directions in which investigations are desirable are indicated.

The use of aeroplanes in surveys to delimit and determine the intensity of insect infestations has also increased rapidly during the last few years, and research on methods for the survey of forest insects is being carried out in Maryland and Oregon. Both visual and photographic methods have been developed, the former including a line strip method, in which observers record the degree of infestation through electrically operated pens on a moving chart as the aeroplane is flown along predetermined flight lines, and sketch mapping, in which they plot infested areas on existing aerial photographs or on planimetric maps. The first has been found suitable for surveying infestation by *C. fumiferana* and the larch sawfly [*Pristiphora erichsonii* (Htg.)], and the second for appraisal surveys of areas infested by defoliators and some bark-beetles. Aerial colour photography, though more expensive, has been found useful for surveys of damage by the white-pine weevil [*Pissodes strobi* (Peck)] and bark-beetle infestations of certain types.

Hills (O. A.), Taylor (E. A.) & Valcarce (A. C.). **Resistance of *Lygus* Bugs to DDT on Sugar Beets grown for Seed.**—*J. econ. Ent.* **49** no. 1 pp. 94–95, 3 refs. Menasha, Wis., 1956.

Lygus hesperus Knight, *L. lineolaris* (P. de B.) and *L. elisus* Van D. reduce the production of sugar-beet seed in the United States [*cf. R.A.E.*, A **32** 216], but were controlled by dusting with 30 lb. 5 per cent. DDT dust per acre from aeroplanes [*cf.* **36** 11] in the Salt River Valley of Arizona from 1946 to 1952. The treatment was not successful in all fields in 1953, and records of *Lygus* populations in fields receiving it in 1954 showed them to average 2·5, 0·8 and 1·3 per sweep before dusting and 6–9 and 10–17 days

after it, respectively, as compared with 4·6, 0·3 and 0·2 before and 1–8 and 15–39 days after dusting in 1945.

In field tests to compare dusts of 5 per cent. DDT and 10 per cent. toxaphene, both applied by aeroplane at 30 lb. per acre on 25th April in one field and 2nd May in another, weekly sampling indicated that populations of the Mirids were reduced by both treatments and remained low on the toxaphene plots until the last date of sampling, 19–24 days later, when the seeds had matured enough to resist *Lygus* attack. On the DDT plots, however, they reached the same level after 11–17 days as before treatment, and dusting was repeated to prevent excessive damage to the seed. Reinfestation was primarily due to the nymphs that hatched from eggs laid before treatment. The DDT residue had killed the newly hatched nymphs in 1944–46, and this change in effect may indicate the development of resistance to DDT. This would be favoured by the exposure of the insects to DDT on cotton as well as on beet, since large areas of cotton in the valley are dusted with DDT several times a year for *Lygus* control.

Douglass (J. R.), Peay (W. E.) & Cowger (J. I.). **Beet Leafhopper and Curly Top Conditions in the southern Great Plains and adjacent Areas.** —*J. econ. Ent.* **49** no. 1 pp. 95–99, 2 maps, 7 refs. Menasha, Wis., 1956.

The following is based on the authors' summary. In 1953, sugar-beet in south-western Kansas was severely affected by curly-top disease and there was a reduction of about 50 per cent. in yield. Investigations in 1954 indicated that the spring breeding areas of *Circulifer tenellus* (Baker), the vector of the virus, had extended north and east of the previously known area and that the disease was widespread throughout the southern Great Plains and adjacent areas.

The factors that favoured this extension of the breeding areas were overstocking and intensive grazing of grassland, which killed or reduced the grass stands, the abandonment of cultivated land because of drought, the destruction of undergrowth and trees, which encourages weeds, soil erosion and the appearance of new species of weeds. Rain is the most important single factor limiting the distribution of *C. tenellus*; its major breeding areas are in country where the mean annual rainfall is not more than 12 ins., and almost all the southern region of the Great Plains normally receives more than this. The importance of the insect should therefore not be great there during seasons of normal or high rainfall.

Gibson (K. E.). **Cultural Practices affecting Wireworm Injury to Potatoes.** —*J. econ. Ent.* **49** no. 1 pp. 99–102, 4 refs. Menasha, Wis., 1956.

The following is based largely on the author's summary. The effects of different quantities of irrigation water and times of planting on the injury to potato by wireworms, chiefly *Limonius canus* Lec., were tested in field plots in Washington in 1934–37. Populations of larvae and adults were estimated each spring before planting and each autumn after harvest, and tubers were examined for injury and the soil immediately round them for wireworm abundance and distribution at intervals during the season. Generally more wireworms were found in soil samples as the season advanced and as those of the new generation increased in size. Reductions in irrigation water tended to reduce injury, but also reduced the value of the crop and did not give practical control. Injury was also progressively reduced as the planting date was delayed, and potatoes planted on 20th June or later

suffered little damage as they did not set tubers until August, by which time many larvae had moved down from the top six inches of soil to avoid high temperatures. There was also a general reduction in feeding during September and October, regardless of soil depth.

CARMAN (G. E.). **Field Evaluation of Malathion for Control of California Red Scale on** *Citrus*.—*J. econ. Ent.* **49** no. 1 pp. 103–111, 12 refs. Menasha, Wis., 1956.

As malathion gave promising results in preliminary laboratory and field tests on the control of *Aonidiella aurantii* (Mask.) on *Citrus* in California, investigations were carried out in 1951–54 to compare it with oil emulsions and parathion sprays, which are the established means of control.

On navel orange sprayed in September or October in each of the years 1951, 1952 and 1953, the percentages of fruits and leaves infested with adult females and the numbers of scales on terminal green-wood twigs showed slight reductions ten months after treatment in the first year with 2–4 lb. 25 per cent. wettable malathion per 100 U.S. gals., and this trend became more apparent after each successive treatment. Infestation was also gradually reduced by annual applications of 0·5–1 lb. 25 per cent. malathion. The results of this and other tests suggested that malathion may be more effective against the scale on leaf and bark surfaces than on fruits. Raising the concentration of the wettable powder to above 2 lb. per 100 U.S. gals. tended to improve control on Valencia orange sprayed in spring or autumn, and autumn and spring applications at 3 lb. gave excellent control of a moderate infestation on lemon, whereas similar applications at 4 lb. were ineffective against an extremely heavy one. Such high doses are not economic, but the effectiveness of the lower rates against light populations and the increased control given by repeated applications, in contrast to the effect of repeated oil sprays, suggest that malathion should be applied annually to prevent the development of injurious infestations.

Single applications on navel or Valencia orange in late summer or autumn were less effective than single applications at lower concentrations in spring or early summer, and treatment in the immediate post-bloom period appeared to be the best. Two applications, two or four months apart, in March–July, were much more effective than one at the same rate, with little difference between concentrations of 1, 1·5 or 2 lb. wettable powder per 100 U.S. gals.; though somewhat impracticable for the control of *Aonidiella* alone, these might be combined with sprays for other purposes. In view of indications that malathion at practicable dosages was less effective than petroleum oil or parathion, it was further tested in combination with these materials. The results given by mixtures of 0·5, 0·75 or 1 lb. 25 per cent. malathion with each of these concentrations of 25 per cent. parathion suggested the use of 1 lb. of each wettable powder, with the possibility that the concentration of malathion rather than that of parathion might be increased if a heavier dose were needed. The inclusion of 0·5 lb. 25 per cent. malathion per 100 U.S. gals. in oil sprays improved control, and the improvement was proportionately greater for 1 or 1·5 lb. Reducing the oil concentration from 1·75 to 1·25 or 0·75 per cent. in sprays containing 1 lb. 25 per cent. malathion decreased the effectiveness of the first application, but the reduction was less for repeated ones. Light-grade oil appeared to be adequate against *A. aurantii*, but it might be ineffective against other pests, even with the addition of malathion; the type of oil formulation did not appear to affect control. The addition of 1 lb. 25 per cent. malathion to 1·75 or 2 U.S. gals. light or medium oil per 100 U.S. gals. improved control of *Aonidiella* on lemon when applications were made in autumn and spring. The use of kerosene in malathion sprays

gave favourable control on orange when applications were made during the post-bloom period, but this was no cheaper than comparable control with parathion or malathion alone. In applications made in the autumn of 1951 and the spring of 1952 against an extremely heavy infestation on lemon, malathion alone had less effect than oil emulsion or parathion and gave better results when applied in spring after autumn treatment with oil or parathion than when applied in autumn before spring treatment with these materials. Two mist-blower applications, a month apart, in which malathion was used alone or with parathion, were less effective than one using double the quantity of spray at the same concentration.

The malathion treatments tested had no adverse effect on the trees, and though they did not adequately control other insects or mites, they did not appear to cause an increase in numbers. It is concluded that malathion can be used effectively for the control of light and moderate infestations of *Aonidiella*, provided that dosages of more than 2 lb. 25 per cent. wettable powder per 100 U.S. gals. are applied during the immediate post-bloom period, and that it can also be usefully combined with parathion or oil emulsions.

Hyche (L. L.) & Eden (W. G.). **Effect of Formulations and Methods of Application of Insecticides on the Control of Wireworms on Sweet Potatoes.**—*J. econ. Ent.* **49** no. 1 pp. 111–113, 5 refs. Menasha, Wis., 1956.

Experiments were carried out in Alabama in 1953 and 1954 to determine the effectiveness of various formulations and methods of application of insecticides in protecting sweet potatoes from wireworms of the genus *Conoderus*. Dusts and granules were applied to the soil with fertiliser or broadcast 1–2 weeks before the slips were set, and emulsions were added to the water used at planting. The insecticides tested were aldrin, lindane [almost pure γ BHC], heptachlor and dieldrin, applied at 2 lb. technical material per acre, and the plants were harvested 150–180 days after treatment.

Aldrin, lindane and heptachlor were tested in two districts in which wireworm injury was light, and statistical analysis of the average results for the two years showed that all treatments except the application of heptachlor granules in fertiliser resulted in significant decreases in the percentage of sweet potatoes damaged. Where aldrin and dieldrin were tested under conditions of severe wireworm injury, all treatments but one significantly reduced damage. Broadcast application of granules appeared to be slightly more effective than the others, and emulsions added to the transplant water the least effective; aldrin applied in this way failed to reduce the injury significantly.

Yields were somewhat variable in all tests, and there were no significant differences due to treatment except that γ BHC in the transplant water resulted in significantly lower yields than no treatment.

Cox (H. C.), Brindley (T. A.), Lovely (W. G.) & Fahey (J. E.). **Granulated Insecticides for European Corn Borer Control.**—*J. econ. Ent.* **49** no. 1 pp. 113–119, 3 figs., 4 refs. Menasha, Wis., 1956.

Since granular insecticides applied to maize were found to roll gradually into the whorls [*cf. R.A.E.*, A **41** 371] and leaf axils, they were tested in Iowa in 1953–54 against young first- and second-generation larvae of *Pyrausta nubilalis* (Hb.), which feed in these two situations, respectively. Application

was by power duster and two modified grass seeders, at 20 lb. granules per acre.

Against the first generation, there were no significant differences between DDT, heptachlor and EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate], applied at 1–1·5, 1·5–2 and 0·1 lb. active ingredient per acre, respectively, in 1953, all giving highly significant control, attapulgite formulations were superior to those on a tobacco base, and the grass seeder used did not give much better results than the power duster, though less material was wasted and there were fewer mechanical breakdowns; there were no significant differences between DDT, malathion, heptachlor and EPN at 1·5, 2, 1·5 and 0·5 lb. per acre, respectively, or between attapulgite and tobacco-base carriers in 1954.

Against the second generation, 1 lb. DDT and 2 lb. heptachlor per acre in attapulgite formulations reduced the numbers of larvae by almost 82 and over 90 per cent., respectively, in 1953, and 1·5 lb. heptachlor or DDT and 0·5 lb. EPN per acre reduced them significantly in 1954, whereas 0·75 lb. DDT and 0·25 lb. EPN did not; attapulgite and tobacco-base formulations were equally good, the seeder was more effective than the power duster and there was very little difference between applications of DDT in granules and at the same rate in emulsion sprays.

The date of application of DDT in granules appeared to affect the control of the first but not of the second generation. The best control of the former would probably be obtained by two applications, one at the peak of oviposition and the other at or just after the peak of hatching, and the best with a single application by treatment at or just after the hatching peak; there were no significant differences in numbers of larvae or tunnels in plants treated on 23rd July, three days before deposition of second-generation eggs began, and on 12th August. Up to about 200 times as much DDT residue was found on the leaves and about twice as much on the area of the leaf axils and stalks of sprayed plants as on those treated with granules, but the latter showed more in the actual axils. It is concluded that granular insecticides are at least as effective as emulsion sprays against *P. nubilalis* on maize, and less likely to result in an accumulation of insecticide in the milk of cattle grazing in the fields after harvest.

ARTHUR (B. W.). **Insects in stored Peanuts and their seasonal Abundance.** —*J. econ. Ent.* **49** no. 1 pp. 119–120, 3 refs. Menasha, Wis., 1956.

Investigations on the insects attacking groundnuts stored on farms in Alabama were carried out in 1952–54; the storage period generally lasted from October–November to August, and the groundnuts reached an equilibrium moisture content of about 6 per cent. soon after being transferred to the storage bins. A list is given of the 26 identified insects found, which included six species of Hymenopterous parasites. *Tribolium castaneum* (Hbst.) and *T. confusum* Duv. were the commonest of the Coleoptera, followed by *Carpophilus dimidiatus* (F.) and *Ahasverus advena* (Waltl), and *Plodia interpunctella* (Hb.) was the commonest of the Lepidoptera. Infestation was heavy in November 1953, owing to the presence of insects in the bins from the 1952 crop, lower in March–May 1954 and increased most in July and August; the parasites were most numerous in November.

Examination of all larvae collected from the foreign matter in each sample and from the kernels in one sample in August 1954 showed that *Oryzaephilus surinamensis* (L.), *Trogoderma sternale* Jayne and *Lasioderma serricorne* (F.) were present in the kernels only, and that *P. interpunctella* was almost three times and *C. dimidiatus* only half as numerous in the kernels as in the foreign matter.

Hallock (H. C.) & Deen (O. T.). **Greenhouse Tests on Control of the Beet Leafhopper.**—*J. econ. Ent.* **49** no. 1 pp. 123–126, 4 figs., 1 ref. Menasha, Wis., 1956.

The production of snap-bean seed in southern Idaho is limited by *Circulifer tenellus* (Baker), which feeds little on the plants but transmits the virus of curly top to them [*cf. R.A.E.*, A **42** 388], and 33 chemicals were tested in the greenhouse in 1947–52 for control of this Cicadellid, protection from the virus and toxicity to the plants. They were applied to the plants as sprays at a rate equal to 100 U.S. gals. per acre, usually in emulsified formulations, or as dusts, and the mortality of *C. tenellus* caged on treated leaves was assessed after four days, and protection from infection, and phytotoxicity, after 30. Most of the tests were made on sugar beet, as *C. tenellus* does not usually survive long on beans.

On beet foliage, 0·4 per cent. pyrethrum and 5 per cent. Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] in dusts and 4 lb. lindane [almost pure γ BHC], 2 lb. purified DDT, 1·5 lb. EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] and 1 lb. parathion per 100 U.S. gals. in sprays gave complete mortality, and dusts of 5 per cent. Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane (Prolan) and 1,1-bis(p-chlorophenyl)-2-nitrobutane (Bulan)], methoxy-DDT (methoxychlor) or technical or purified DDT and sprays of 1 lb. purified DDT per 100 U.S. gals. gave 90 per cent. or more; 1,1,1-trichloro-2-(p-chlorophenyl)-2-phenylethane, fluoro-DDT and bromo-DDT at 1, 1 and 1·5 lb. per 100 U.S. gals., respectively, the first two as wettable powders, gave 65, 84 and 67 per cent. control, and the addition of 1·7 lb. piperonyl butoxide to 1·7 lb. toxaphene per 100 U.S. gals. increased the control given by the latter from 23 to 53 per cent. When the treated plants were exposed to viruliferous leafhoppers, the reduction in curly-top infection on non-resistant sugar beet ranged up to 96 per cent., a mist spray of 4·5 lb. technical DDT in 7 U.S. gals. being the most effective. On beans, 5 per cent. Prolan, Bulan, methyl-DDT, methoxy-DDT or purified DDT or 0·125 per cent. schradan in dusts gave 95–100 per cent. control of *C. tenellus*, sprays of 1·5 lb. DDT or Bulan gave 94 and 99 per cent., and a drench of 0·75 or 1 per cent. schradan gave 100 per cent., other materials being less effective. Only the drench gave complete protection from infection, but Prolan, Bulan, methoxy-DDT and 1 per cent. schradan in dusts and bromo-DDT and DDD in emulsion sprays gave effective reductions in some tests and DDT in dusts or emulsion sprays gave more than 50 per cent. reduction. Plant hormones reduced infection by 7–61 per cent. when applied to the seeds or as sprays or soil drenches; naphthaleneacetic acid was the most promising and should be tested further.

Fluoro-DDT caused severe stunting of bean plants at 1·5 lb. but not at 1 lb. per 100 U.S. gals., and ethyl-DDD in a spray at 1·5 lb. or as a 5 per cent. dust caused an increase in growth. Tests of DDT in four dusts and 14 emulsified-solution sprays showed that dusts were generally safer than sprays and purified than technical DDT; purified DDT at 1·5 lb. per 100 U.S. gals. did not harm the plants, but technical DDT at the same concentration in a commercial solvent containing chiefly di- and trimethylnaphthalenes caused significant stunting.

Smith (R. H.). **The Rearing of *Lyctus planicollis* and the Preparation of Wood for Control Tests.**—*J. econ. Ent.* **49** no. 1 pp. 127–129, 3 figs. Menasha, Wis., 1956.

The following is based on the author's introduction and summary. *Lyctus planicollis* Lec. causes extensive damage in the United States to seasoned

hardwood products, and an easy and rapid method was developed for rearing large numbers of adults for use in chemical-control tests. Oak or hickory branches, 1–3 ins. in diameter, are cut during the dormant season, in order to obtain wood with a maximum of starch, freed from bark and cut into sections 10–12 ins. long, and then split into convenient sizes. After rapid seasoning to less than 18 per cent. moisture content, the sections are exposed to attack in containers, closed with muslin to exclude natural enemies. Some of the resultant beetles mature in 3–4 months, but most require 9–12 months. Collection of the emerging adults is facilitated by placing pieces of freshly cut, seasoned wood on top of the old sections; the beetles are attracted to the fresh material and can be removed on it. Wood can be prepared by the same method for use in tests of insecticides.

Harries (F. H.) & Matsumori (H.). **Tests of Insecticides for Control of Cucumber Beetles in Ohio.**—*J. econ. Ent.* **49** no. 1 pp. 131–133, 10 refs. Menasha, Wis., 1956.

In Ohio, *Acalymma vittata* (F.) and *Diabrotica undecimpunctata howardi* Barber cause much injury to cucurbits, particularly the seedlings, and various insecticides were tested against them in 1945–52. In laboratory tests with eight materials in 1 per cent. dusts, with which the beetles were kept in contact for 24 hours, all caused significant mortality of *Acalymma*, parathion giving 100 per cent., EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] and dieldrin 94 per cent. and malathion and NPD [tetra-n-propyl dithionopyrophosphate] 80–81 per cent. kill; these did not differ significantly from each other but were significantly better than aldrin, endrin and isodrin, respectively. Malathion gave 95 per cent. and the other materials 100 per cent. kill of *Diabrotica*. In similar tests, lindane [almost pure γ BHC] and Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] caused 98 and 94 per cent. mortality and heptachlor, Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] and chlordane lower but significant mortality of *Acalymma*, whereas toxaphene, Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl-2-nitrobutane] and A-42 (arsenomethane As-1,2-disulphide) were inferior.

In field tests in small plots of cucurbits infested mainly by *Acalymma*, in which the insecticides were applied 1–4 times at intervals of about a week, for as long as the insects were present in appreciable numbers, rotenone, γ BHC, EPN, dieldrin, aldrin, heptachlor, Bulan [1,1-bis(p-chlorophenyl)-2-nitrobutane] and DDT appeared to be the most effective materials; their relative value was difficult to determine because of the movements of the insects, but they gave good control in 1–2 per cent. dusts.

Finney (G. L.). **A fortified Carrot Medium for Mass-culture of the Oriental Fruit Fly and certain other Tephritids.**—*J. econ. Ent.* **49** no. 1 p. 134, 1 ref. Menasha, Wis., 1956.

Christenson (L. D.), Maeda (S.) & Holloway (J. R.). **Substitution of dehydrated for fresh Carrots in Medium for rearing Fruit Flies.**— *T. c.* no. 1 pp. 135–136, 2 refs.

In the first of these papers, the author reports that a laboratory was set up in Hawaii by the University of California in October 1949 to develop mass-culture methods for rearing parasites of *Dacus dorsalis* Hend. A satisfactory medium had first to be devised for culturing the Trypetid, and one consisting of carrots, washed, shredded and reduced to a gravy-like consistency in a high-speed blender with only enough water to facilitate blender activity,

proved very effective; 1·04 gm. 0·13 per cent. Butoben (n-butyl p-hydroxybenzoate), to suppress the growth of undesirable moulds and yeasts, 16 gm. 2 per cent. powdered brewers' yeast, to compensate for nutritional deficiences in the carrots, and 15 cc. 2N hydrochloric acid, to inhibit the development of bacteria, were added per 800 cc. The medium is stable and can be prepared several days in advance if stored at 38–45°F. Unlike media of banana and synthetic agar, which were the next best, it has a film of liquid on the surface of such consistency that the young larvae can move freely over it, and this considerably reduces mortality. A depth of not less than an inch is desirable to prevent desiccation during the six days of larval development, but the medium tends to remain open in tunnel-like channels behind the feeding larvae, particularly during the later stages of growth, and so permits feeding throughout its depth with adequate air supply, and not only at the top, as in other media. The larvae produced were resistant to disease introduced by an invasion of *Nosema*, and 21–23 thousand eggs in 3,200 cc. of medium yielded about 15 thousand mature larvae, of which 95 per cent. transformed to adults.

The medium was also used with some success for rearing *Ceratitis capitata* (Wied.). Production was somewhat erratic, but up to half the eggs normally gave rise to full-fed larvae. It could not be used for *Dacus cucurbitae* Coq., however, since the larvae did not tolerate Butoben, and the medium deteriorated rapidly without it and gave rise to larvae that were too weak to resist infection by *Nosema*.

It is stated in the second paper that, in experiments carried out in early 1955, the substitution of dehydrated for fresh carrots in the medium resulted in larvae of *D. dorsalis* that were more uniform in size and also improved the rearing of *D. cucurbitae* and *C. capitata*, though difficulties were still encountered in the production of the last. Milled dehydrated carrot powder is passed through a 28-mesh nylon sieve. The fine part is suitable for *D. dorsalis* and *C. capitata*, and the larger granules are used to prepare a rather dryer mixture for *D. cucurbitae*. Other nutrients and antibiotics may be added before or after the addition of water to the powder (7:1). This modification halves the cost of materials and permits exact moisture control.

App (B. A.), Carter (R. H.) & Ely (R. E.). **Residues on Forage, in the Soil, and in Milk following Pasture Treatment with granulated Dieldrin.** —*J. econ. Ent.* **49** no. 1 pp. 136–137, 1 ref. Menasha, Wis., 1956.

In tests on the insecticide residues left in pastures by treatment with dieldrin in granules and the amount excreted in the milk of cows allowed to graze on them, carried out in Maryland in the summer of 1954, two three-acre fields containing mostly blue grass [*Poa*] were treated on 14th June with 0·53 and 4·18 lb. dieldrin per acre, respectively, in 0·5 and 2·5 per cent. granules prepared from 30/60 mesh attapulgite. Examination of samples taken 1–2 days after treatment and at approximately weekly intervals for a month showed dieldrin residues varying irregularly between 2·2 and 4·6 parts per million and decreasing fairly regularly from about 30·6 to 6·4 p.p.m., respectively, on air-dried forage from the two fields, and of 0·34–0·7 and 2·45–3·92 lb. per acre in the soil. Cows that grazed in the fields during the first 14 days after treatment excreted 0·18–0·21 and 0·96 p.p.m. dieldrin, respectively, in the milk, those grazing 4–12 days after it excreted 0·15 and 0·52 p.p.m., and those grazing 15–22 days after it excreted 0·11 and 0·04 p.p.m.

It is concluded that although more than 60 per cent. of the dieldrin applied was recovered from the soil one day after treatment, enough adhered to the

vegetation to leave considerable residues and to contaminate the milk of cows grazing on it.

Wave (H. E.), Shands (W. A.) & Simpson (G. W.). **Recently discovered Primary Hosts of the Foxglove Aphid.**—*J. econ. Ent.* **49** no. 1 p. 137, 3 refs. Menasha, Wis., 1956.

Foxglove (*Digitalis purpurea*) was recorded by Patch as the primary food-plant of *Macrosiphum solani* (Kalt.) (*Myzus pscudosolani* Theo.) in Maine [*R.A.E.*, A **17** 81], but this plant is almost absent from the potato-growing districts of the State, where the Aphid is an important pest of the crop, and other primary food-plants have been recorded for it in Europe. Investigations were therefore begun in 1943 and intensified and extended to New Hampshire in 1953 to find the primary food-plants from which the Aphid migrates to potato in north-eastern Maine. In May 1954, mature fundatrices and young were observed in several places on hemp nettle (*Galeopsis tetrahit*) in or near undisturbed fields that had been planted with potatoes in 1953. Large populations developed, and spring migrants began to mature about 8th June. In the autumn of 1954, oviparae, wingless males and eggs were found on the same plant, and also, with viviparae, on species of hawkweed (*Hieracium*); eggs were observed on 10–33 per cent. of the hawkweed plants in six infested areas. Infestation of hawkweed was heaviest in protected positions and occurred both at the borders of potato fields and ten miles or more from them; the presence of dead parasitised viviparae at the most distant points suggested that the Aphid also lives on this plant in summer. Observations in the spring of 1955 showed that the eggs overwintered on hawkweed and that the Aphid bred on it throughout the spring. Hemp nettle is an annual plant and hawkweed a perennial, and it was not known whether the fundatrices that initiated the spring colonies on the former hatched from eggs on adjacent dead hemp nettle or from those on hawkweed. Patch indicated the development of autumn migrants in late summer [**17** 82], but the occurrence of a true autumn migration has been denied in Europe. The authors' observations showed that winged forms seldom developed on potato or other secondary food-plants in late summer or autumn.

Munger (F.). **Activated-carbon Filter for Purification of Air for rearing *Citrus* Red Mite.**—*J. econ. Ent.* **49** no. 1 p. 138, 1 ref. Menasha, Wis., 1956.

Attempts to rear *Metatetranychus citri* (McG.) in the laboratory in California were unsuccessful until fresh air was circulated in the rearing room [*cf. R.A.E.*, A **44** 56], and as the need for conditioning the introduced air made it difficult to maintain controlled temperature and humidity, other ways of removing possible laboratory air contaminants were sought.

In a preliminary test, the mite was reared successfully from November 1954 to April 1955, when the experiment ended, at a temperature of about 77°F. and 60–70 per cent. relative humidity, in a tightly closed cabinet of 6 cu. ft. capacity provided with a filter containing activated carbon, through which air from the cabinet was forced at a rate equivalent to 735 times the volume of the cabinet each hour. In a further test at the same temperature and humidity, batches of ten lemons each bearing five newly emerged females were prepared, and a room was fitted with a filter with an hourly capacity of about five times the volume of the room, which was 1,148 cu. ft. The room received the equivalent of 2½ changes of air from outdoors each

hour, and contained three cabinets. A batch of the infested lemons was put into each, and air from the room equivalent to 34 and four times the volume of the cabinet, respectively, was passed through two of them each hour. The third cabinet had no forced air exchange, but some air entered when it was opened for routine operations. A fourth batch of lemons was exposed in the room, and a fifth was put into the original cabinet, with filter attached. The numbers of eggs laid in 20–21 days and (in brackets) the numbers of females alive after ten days were 2,949 (22), 3,119 (18) and 1,733 (12), respectively, in the first three cabinets, 2,660 (20) in the room, and 2,847 (21) in the original cabinet.

In view of these results, purification of the air in the rearing room with a carbon filtering unit having an hourly capacity of 6·5 times the volume of the room was substituted for the introduction of large quantities of fresh air, with equally good results in the production of mites.

Kaloostian (G. H.). *Ufens niger* (**Ashm.), an Egg Parasite of the Geminate Leafhopper.**—*J. econ. Ent.* **49** no. 1 p. 140, 4 refs. Menasha, Wis., 1956.

During studies on the life-history of *Colladonus geminatus* (Van D.) in Utah, adults of *Ufens niger* (Ashm.) emerged in April 1954 from eggs of the Cicadellid laid in the previous autumn in leaves of mazzard cherry seedlings.

Lejeune (R. R.), Fell (W. H.) & Burbidge (D. P.). **The Effect of Flooding on Development and Survival of the Larch Sawfly** *Pristiphora erichsonii* **(Tenthredinidae).**—*Ecology* **36** no. 1 pp. 63–70, 3 graphs, 6 refs. Brooklyn, N.Y., 1955.

The following is almost entirely the authors' summary of this account of field and laboratory studies in Manitoba in 1949–50 on the influence of ground water on the development and survival of the cocoon stages of *Pristiphora erichsonii* (Htg.) [*cf. R.A.E.*, A **38** 1]. The peak occurrence of post-diapause stages of development in the sawfly cocoons varies according to season, but took place during 8th–25th June in 1949 and 15th–30th June in 1950. During this period, the sawfly is susceptible to flooding, and almost complete mortality is caused by flooding for one week or more. Overwintered eonymphs in diapause are highly resistant to flooding in spring, immersion for about 50 days being necessary to produce complete mortality, and immersion for two weeks giving about 50 per cent. kill. The post-diapause stages are much more susceptible, and immersion for 21, 7 and 2 days results in complete mortality of pronymphs, pupae and unemerged adults, respectively. The development of insects that survive flooding for 1–3 weeks is greatly retarded, adults emerging a month or more later than in unflooded material and the delay being roughly proportional to the duration of immersion. Up to four weeks after the formation of their cocoons, the larvae are highly susceptible to flooding for periods of 2–4 weeks. They then become progressively more resistant, and at 8–10 weeks after cocoon formation, submergence for two weeks or less has no significant effect. Short periods of flooding may not only kill larvae in newly formed cocoons immediately by drowning, but delayed mortality may occur for at least six weeks after flooding has ceased. It is not known how much mortality among overwintered stages in cocoons can be attributed to flooding for short periods in spring, but the amount is probably considerable. The rate of oxygen consumption of larvae in newly formed cocoons is not directly proportional to susceptibility to flooding, but is probably an important factor in it. In

overwintered eonymphs and post-diapause stages, susceptibility appears to be directly related to oxygen consumption.

Abrahão (J.) & Orlando (A.). **Notas sôbre** *Macrodactylus pumilio* **Burm., como praga de diversas culturas e seu contrôle com inseticidas modernos.** [Notes on *M. pumilio* as a Pest of various Crops and its Control with modern Insecticides.]—*Biológico* **22** no. 9 pp. 147–155, 1 fig., refs. São Paulo, 1956. (With a Summary in English.)

Adults of *Macrodactylus pumilio* Burm. were numerous in parts of São Paulo, Brazil, in November–December 1955 and damaged a wide variety of plants. Injury to *Citrus* was severe, up to 100 per cent. of the flowers being damaged on varieties of orange that came into blossom at the time of the outbreak, and feeding was also observed on the young leaves and shoots, the flowers of avocado and various ornamental plants, the silks of maize, peach fruits, cashew nuts and the petals and young shoots of roses. The adults of the Melolonthid are briefly described. The females oviposit in the soil, and the larvae feed on organic matter and the roots of plants.

Experiments on control were carried out in the laboratory with field-collected adults, for which rose petals and young orange shoots were provided as food. Dusts were applied to the beetles by a technique already described [*R.A.E.*, A **37** 471], at a rate of 200 mg. per test. The percentages of mortality in 24 hours, as compared with 3·3 for no treatment and 18·3 for treatment with talc alone, averaged 100 for BHC (1–2 per cent. γ isomer), 2 per cent. lindane [almost pure γ BHC], 0·5–1 per cent. parathion, 1·5 per cent. Chlorthion [O,O-diethyl O-3-chloro-4-nitrophenyl phosphorothioate], 2 per cent. endrin or dieldrin, 3 per cent. aldrin, and a mixture containing 0·8 per cent. piperonyl butoxide and 0·05 per cent. pyrethrins, 96·6 for 5 per cent. DDT or 3 per cent. malathion, 93·3 for 20 per cent. toxaphene, 83·3 for 3 per cent. DDT, and 66·6 for 1 per cent. endrin. The mixture of piperonyl butoxide and pyrethrins was the most rapid in action, all the adults showing symptoms within nine minutes of application. Good control was obtained in the field with 1 or 2 per cent. BHC and 0·5 or 1 per cent. parathion in dusts, and with 0·2 per cent. of emulsion products containing 27 per cent. γ BHC or 5 per cent. parathion in sprays. There were no phytotoxic effects. DDT in a 5 per cent. dust was inferior.

Lizer y Trelles (C. A.). **Ensayos para la destrucción de la** *Fidicina mannifera*, **chicharra de la yerba mate.** [Tests on the Destruction of *F. mannifera* attacking Maté.]—*Bol. Fac. Agron. Vet. B. Aires* no. 33, 13 pp., 4 figs., 9 refs. Buenos Aires, 1956. (With a Summary in English.)

In view of the damage to maté tea [*Ilex paraguensis*] in Misiones, Argentina, caused by *Fidicina mannifera* (F.) in recent years, tests on the control of the nymphs were made in 1955. The bionomics of this Cicadid are briefly reviewed [*cf. R.A.E.*, A **44** 98], and it is stated that the nymphs require more than one year to complete their development in the soil. The tests were carried out on trees some 20 years old in a planting in which 30 or more nymphs had been found on the roots of individual trees. In the first series, liquids were applied to the roots, at the rate of about 5·5 gals. per tree, after the soil round the base had been removed to a depth of about 4–5 ins. to facilitate penetration. Complete kill of nymphs was obtained with an 80 per cent. carbon-bisulphide emulsion concentrate at the rate of

253 cc. per tree, but similar treatments with chlordane, heptachlor, lindane [γ BHC], E 605 [parathion], Metasystox [dimethyl 2-(ethylthio)ethyl phosphorothioate (methyl-demeton)] and Isolan [1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate] were ineffective. In the second series, liquid methyl bromide was applied to the soil at a depth of 4 ins. by means of five holes round the trunk at a distance of about 12 ins. from it, at a rate of 20–25 cc. per hole. This treatment gave almost complete mortality, and a reduced dosage of 5–10 cc. per hole was about as effective. Similar treatment with carbon bisulphide at 40 cc. per tree gave poor results. Methyl bromide is recommended, in view of the ease of application.

Sherman (M.) & Tamashiro (M.). **The Sweetpotato Weevils in Hawaii. Their Biology and Control.**—*Tech. Bull. Hawaii agric. Exp. Sta.* no. 23, 36 pp., 10 figs., 56 refs. Honolulu, 1954.

The following is based on the authors' summary. *Euscepes postfasciatus* (Fairm.) and *Cylas formicarius elegantulus* (Summers) are the most important pests of sweet potato in Hawaii, the injury caused by them rendering the tubers unmarketable and even unpalatable to livestock. Laboratory observations on their bionomics showed that the eggs of these weevils, which are laid singly in the vines or tubers, hatch in about eight days. At a mean temperature of 80·3°F., the larval stage lasted 18–24 days for *Euscepes* and 15–20 days for *Cylas*, and the pupal stage, which is passed in the tubers or stems, 9 and 8 days, respectively. Adults of both species survived for about a month in the absence of food and water. Their habit of feigning death when disturbed makes them difficult to detect in the field.

Infestation arises chiefly from the use of infested cuttings and the crawling of adults from adjacent fields; *Cylas* flies rarely and *Euscepes* not at all. No effective natural or biological control factors are known, but certain cultural practices, which are noted, afford some protection against attack. In laboratory tests in which nine insecticides in acetone solution were applied topically to adults, the LD50's for *Euscepes* and (in brackets) *Cylas* in mg. per gm. were 0·0184 (0·00381) for parathion, 1·62 (0·289) for p,p'DDT, 0·135 (0·133) for γ BHC, 0·394 (2·2) for chlordane, 1·15 (1·4) for toxaphene, 0·0116 (0·161) for aldrin, 0·128 (0·0513) for isodrin, 0·012 (0·178) for dieldrin and 0·0408 (0·0365) for endrin. When various insecticides were tested in the field as sprays, dusts and soil treatments, DDT applied as a preplanting dip to the cuttings followed by sprays at 10 and 16 weeks after planting at the rate of 2 lb. DDT per 100 U.S. gals. gave excellent control [*cf. R.A.E.*, A **42** 6]. DDT dusts were inferior to sprays. The flavour of the tubers was not impaired.

Tanada (Y.) & Holdaway (F. G.). **Feeding Habits of the Tomato Bug, *Cyrtopeltis* (*Engytatus*) *modestus* (Distant), with special Reference to the Feeding Lesion on Tomato.**—*Tech. Bull. Hawaii agric. Exp. Sta.* no. 24, 40 pp., 12 figs., 91 refs. Honolulu, 1954.

Cyrtopeltis modesta (Dist.), of which *C. lurida* (Gibson) [*R.A.E.*, A **40** 291] is a synonym, injures tomato in Hawaii by feeding on the younger growing parts, and causing lesions, referred to as feeding rings, which weaken the stems and petioles. The development of these lesions was studied and the following is based on the authors' summary of the results.

The lesion is the result of numerous feeding punctures made in a complete or incomplete ring round the stem or petiole [*cf.* **37** 310]. The salivary

secretions of the Mirid are toxic but do not produce intense cellular reactions in the plant. The external and internal characteristics of the lesions were in general similar to those of lesions made artificially with sterile needles. The path of the stylets is intracellular, and their path is occasionally indicated by a collapsed mass of cell contents, apparently different from the stylet sheaths of Homoptera, though the brown streak formed by the collapsed dead cells has a superficial resemblance to the latter. The vascular tissue appeared to be the main site of feeding, though the cortex, endodermis, pericycle and pith were also fed on. Dyes were taken up from xylem tissue.

Lesions were produced by nymphs in all five instars, though less readily by those in the first three. The bug has an unusual habit of returning to former feeding sites, especially to mature lesions, and is also attracted to fresh wounds. The tissues within the lesions have an increased content of protein, dextrin and reducing sugars and a reduced starch content, and the presence of these large amounts of nutritive organic substances makes the lesions suitable feeding sites.

The bug feeds mainly on young shoots and flowers. In the field, populations were found to decrease in density down the stems, the majority of adults and nymphs occurring on the top 7 ins. They were also more numerous on plants with a high nitrogen content.

Brien (R. M.) & others. **Diseases and Pests of Peas and Beans in New Zealand and their Control.**—*Bull. N.Z. Dep. sci. industr. Res.* no. 114, 91 pp., 77 figs. Wellington, N.Z., 1955.

Notes are given on the invertebrate pests (mostly insects) and the virus and other diseases that commonly attack garden and field peas, dwarf and runner beans, and broad beans [*Vicia faba*] in New Zealand. The information on insects and mites relates chiefly to their appearance, bionomics, food-plants and control, and that for the virus diseases to their symptoms, host-plants and methods of transmission, with mention of insect vectors where appropriate. Tables are included showing the insecticides and fungicides recommended against the different pests and diseases, with the concentrations, rates and times of application, and a list of officially approved proprietary preparations indicating the purpose for which they are intended and the concentrations at which they should be applied.

Smith (L. C.). **DDT resistant Codling Moth: a Report on the 1954/55 Control Trials.**—*J. Dep. Agric. S. Aust.* **59** no. 1 pp. 12–15, 2 figs. Adelaide, 1955.

DDT sprays gave almost complete control of the codling moth [*Cydia pomonella* (L.)] on apple in South Australia until 1952–53. In that season, a grower in the Paracombe district reported a high proportion of injured fruits on trees that had received more than the usual number of sprays, and 80 per cent. of the crop was lost in the following season despite the application of ten sprays of 0·1 per cent. DDT, of which the first four also contained 3 lb. lead arsenate per 100 gals. It was assumed that a strain of *C. pomonella* resistant to DDT had developed, and a survey after harvest showed that it was present over an area of about 0·75 sq. mile; this area was situated in one of the most important apple-growing districts of the State, and the strain of *C. pomonella* in it had shown tolerance to lead arsenate prior to 1945. This is reported to be the first occurrence of extensive resistance of *C. pomonella* to DDT [*cf. R.A.E.*, A **44** 384]. Tests in other parts of South Australia

where DDT failed to give control showed that the failure there was probably due to inadequate spraying.

An attempt was made in 1954–55 to discover a substitute for DDT in the orchard where resistance was first reported, which was very heavily infested. The materials compared, unless otherwise indicated, in emulsion sprays, were DDT, endrin, wettable Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] and wettable malathion at 0·05 per cent. (the concentration recommended for DDT), DDD, methoxy-DDT (methoxychlor) and wettable micronised phenothiazine at 0·1 per cent., and parathion at 0·025 per cent., all applied 12 times at fortnightly intervals between 21st October and 23rd March, parathion at 0·015 and lead arsenate at 0·3 per cent., each applied twice and followed by ten applications of white oil (1:80), and parathion at 0·025 per cent., applied five times, followed by Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] at 0·1 per cent., applied seven times. The materials considered sufficiently promising to warrant further investigation, with (in brackets) the percentages of uninjured fruits at harvest and of windfalls among the total crop, were malathion (80 and 12), parathion alone (61 and 20) or followed by Diazinon (78 and 9) or oil (64 and 50), and, possibly, phenothiazine (73 and 45); the corresponding figures were 12 and 80 for DDT and 67 and 40 for lead arsenate. Trees sprayed with malathion were in particularly good condition at the end of the season, but Diazinon caused slight leaf drop. Although parathion was not outstanding, it gave good commercial control when applied in a similar schedule by growers in the same district; many fruits on the sprayed trees were punctured, but few became infested, and populations of overwintering larvae were greatly reduced. Micronised phenothiazine was effective during spring and summer, but many fruits became infested during hot weather, and it left an unsightly residue. On the basis of these tests, malathion is recommended for use at 0·05–0·075 per cent., or at four times this concentration if concentrated sprays are applied. Treatment at 14-day intervals from petal-fall until risk of infestation is passed is recommended for growers in the Paracombe district.

Ishii (T.) & Yasumatsu (K.). **Description of a new parasitic Wasp of *Ceroplastes rubens* Maskell (Hym., Encyrtidae).**—*Mushi* **27** pt. 10 pp. 69–74, 8 figs. Fukuoka, 1954.

A species of *Anicetus* that parasitises *Ceroplastes rubens* Mask. in Kyushu, Japan, was formerly identified as *A. ceroplastis* Ishii [*cf. R.A.E.*, A **44** 353]. It has since been found to differ from that species and is here described from adults of both sexes as *A. beneficus*, sp. n. It has been introduced against *C. rubens* in Shikoku and Honshu [*cf.* **44** 354].

Yasumatsu (K.) & Yamamoto (S.). **On the Size of *Anicetus beneficus* Ishii et Yasumatsu (Hym., Encyrtidae).** [*In Japanese.*]—*Sci. Bull. Fac. Agric. Kyushu* **15** no. 2 pp. 187–193, 4 graphs, 4 refs. Fukuoka, 1955. (With a Summary in English.)

A biometrical study of the adults of *Anicetus beneficus* Ishii & Yasumatsu, which parasitises *Ceroplastes rubens* Mask. in Japan [*cf.* preceding abstract], showed that those of the first generation are larger than those of the second. Since reproductive capacity and length of life of the parasite vary directly with size [*cf. R.A.E.*, A **44** 354], the best control of *C. rubens* will be obtained by liberation of first-generation individuals.

Schvester (D.). **Essai de lutte contre le puceron cendré du poirier** *Sappaphis pyri* **Fonsc. par traitement d'hiver.**—*Phytiat.-Phytopharm.* **3** no. 3 pp. 125–128, 3 refs. Paris, 1954.

Tests with winter sprays against *Anuraphis* (*Sappaphis*) *pyri* (Boy.) on pear were carried out in 1954 in an orchard near Lyons that had been heavily infested in the previous year. The sprays were applied on 9th March, just before bud-burst, and the trees were examined on 17th May. On that date, the percentages of trees on which colonies of the Aphid were found were 0·8 for 2 per cent. of an emulsion of the mayonnaise type containing 75 per cent. mineral oil and 5 per cent. DNC, 3·4 for 1 per cent. of a product of the soluble-oil type containing 50 per cent. oil and 10 per cent. DNC, and 5 for 0·5 per cent. of a product containing 20 per cent. DNC, as compared with 40 on untreated trees surrounded by treated ones and 20 (rising to 35 by 31st May) on untreated ones isolated from the treated blocks. The number of colonies per infested tree was much greater on the untreated than on the treated trees. Complete mortality was given by a single application, after the counts on 17th May, of an emulsion spray containing 0·03 per cent. Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate). When the same spray was applied on 1st and 4th June to trees in the isolated untreated block, about 98–100 per cent. mortality was observed after the second application.

Schvester (D.) & Gireau (R.). **Nouvelles expériences de traitements d'hiver contre la cochenille floconneuse de la vigne:** *Pulvinaria vitis* **L.**—*Phytiat.-Phytopharm.* **3** no. 3 pp. 129–131, 1 ref. Paris, 1954.

Experiments on the value of winter sprays against *Pulvinaria vitis* (L.) on vines were carried out in a neglected severely infested hillside vineyard near Lyons in 1954. Good results against this Coccid had been obtained in the previous year by spraying with 8 per cent. of an emulsion product containing 55 per cent. tar distillate (anthracene oil) and 17 per cent. mineral oil, and with 3 per cent. of one containing 45 per cent. tar distillate and 10 per cent. DNC. In 1954, the sprays were applied on 17th–18th March, and the surviving females were counted on 17th June. The average numbers per stock were 0·27 and 0·26 for 6 and 8 per cent., respectively, of the product containing tar distillate and oil, 2·82, 2·52 and 1·81 for 3, 4 and 5 per cent., respectively, of the mixture of tar distillate and DNC, and 11·46 and 1·46 for 4 and 5·5 per cent., respectively, of an emulsion product containing 80 per cent. tar distillate, as compared with 14·1 for no treatment.

Anglade (P.). **Essais de lutte chimique contre la noctuelle des moissons** *Euxoa segetum* **Schiff. nuisible au maïs dans le sud-ouest.**—*C.R. Acad. Agric. Fr.* **40** no. 13 pp. 525–528, 1 ref. Paris, 1954.

As larvae of *Agrotis* (*Euxoa*) *segetum* (Schiff.) cause considerable damage to maize and other crops in south-western France, laboratory and field tests on their control were carried out in 1953. When field-collected larvae in the last instar were kept in soil previously saturated with insecticide and provided with untreated maize leaves, the numbers of days required for all the larvae to cease activity and (in brackets) for complete mortality were 1 (3) for a liquid containing 0·2 per cent. aldrin, 1 (5) for 0·2 per cent. dieldrin, 8 (9) and 2 (5) for 0·4 per cent. toxaphene alone and with 0·015 per cent. parathion, respectively, 2 (6) for 0·2 per cent. DDT in oil, 7 (9) for a mixture of 0·2 per cent. DDT and 0·035 per cent. lindane [almost pure γ BHC] and 7 (14) for 0·2 per cent. chlordane. Activity remained normal in untreated

soil. Mortality did not reach 100 per cent. when the larvae were kept in the treated soil for two hours only and then transferred to untreated food, but was somewhat higher for larvae in the penultimate than in the last instar. All the products tested proved toxic to the larvae when applied to maize leaves.

In the field, sprays were applied to maize in early June, when the first signs of attack appeared and the population averaged one second- or third-instar larva per 10 plants. The sprays, which unless otherwise stated were in emulsion form, were applied at about 45 gals. per acre and directed on to the young plants and the soil along the rows. The plants were examined and damaged ones removed on three occasions, the last being on 15th July, when pupation was beginning. The percentages of plants destroyed in the plots treated with the various insecticides, amounts of active ingredient being given per 15 yards of row, were 4·3 and 1·9 for about 0·15 and 0·2 oz. DDT in oil, 3·1 and 2·5 for 0·05 and 0·1 oz. aldrin, 3·1 for 0·15 oz. chlordane, 7·1 for 0·15 oz. toxaphene and 2·8 for 0·3 oz. of a 1:0·183 mixture of DDT and γ BHC in a wettable powder, as compared with 14·4 for no treatment. In view of these results and others not reported, emulsion sprays applied to give about 0·2 oz. DDT and 0·04 oz. γ BHC (prepared from a 5:1 mixture), 0·2 oz. chlordane or DDT in oil and 0·1 oz. aldrin per 15 yards of row are recommended. Tests with dusts at equivalent concentrations gave inferior results, but when they were incorporated into the soil of the rows at sowing, the percentages of plants destroyed, as compared with 14 for no treatment, were 1·8 and 3·3 for aldrin and chlordane at 0·125 and 0·3 oz. per 15 yards, respectively, and 2·1 for a 5:1 mixture of DDT and γ BHC applied at 0·25 oz. toxicant.

Benassy (C.). **Essai expérimental de constitution d'un foyer de** *Prospaltella berlesci* **How. dans le Lyonnais.**—*C.R. Acad. Agric. Fr.* **40** no. 13 pp. 528–530, 5 refs. Paris, 1954.

In view of the increasing damage caused to peach near Lyons by *Pseudaulacaspis pentagona* (Targ.) [*cf. R.A.E.*, A **43** 27], which readily spreads to it from mulberry, investigations were begun in 1952 to ascertain whether *Prospaltella berlesei* (How.) could survive in the region. This Aphelinid, which is a specific parasite of the Coccid, had occasionally been observed there, though not consistently, and doubt existed as to its ability to overwinter. Parasite material collected from mulberry near Alès was caged in July on two heavily infested mulberry trees or exposed on infested young peach trees in a nursery; the cages were withdrawn in August, after emergence of the adults. Observations in late autumn showed that 7 per cent. of the Coccids on mulberry and 3 per cent. of those on peach were parasitised, and the parasite was recovered in the spring of 1953. The percentage parasitism reached about 53 and 26, respectively, in the autumn of that year and was 15 on peach in late winter and 32 on mulberry in the spring of 1954. *Prospaltella* did not become established on peach in an orchard where releases were made on three trees in July 1952, and this is thought to be due to the absence of ground cover and the consequent lack of shelter from the exceptionally high temperatures and low relative humidity of that summer.

Coutin (R.) & Dusaussoy (G.). **Étude expérimentale de la ponte de** *Balaninus elephas* **Gyll. sur les châtaignes (Col. Curculionidae).**—*Bull. Soc. ent. Fr.* **61** no. 3–4 pp. 62–66, 3 figs., 6 refs. Paris, 1956.

Observations in 1955 showed that 90, 65 and 2 per cent. of the fruits of three varieties of sweet chestnut [*Castanea*] in the Cévennes region of

France were infested by *Curculio* (*Balaninus*) *elephas* (Gylh.). In tests, the degree of infestation was found to be in inverse ratio to the density of the spines covering the pericarp, and the resistance to attack was therefore of a physical nature.

Benassy (C.). **Observations sur la biologie d'*Aspidiotiphagus citrinus* Crwf. (Hym. Chalcidoidea Aphelinidae).**—*Bull. Soc. ent. Fr.* **61** no. 5–6 pp. 103–106, 17 refs. Paris, 1956.

Many Aphelinids are known to be both primary and secondary parasites, and observations in the Department of Alpes-Maritimes in 1955 are recorded showing that they include *Aspidiotiphagus citrinus* (Craw). It was found as a primary parasite of *Quadraspidiotus perniciosus* (Comst.) on apple, peach and pear and *Hemiberlesia rapax* (Comst.) and *Pseudaulacaspis pentagona* (Targ.) on mulberry, all stages from the newly fixed crawlers to the young females being attacked, including the male nymphs, and also as a parasite of late-instar larvae of *Pteroptrix dimidiatus* Westw., *Adelencyrtus aulacaspidis* (Brèth.) and *Apterencyrtus microphagus* (Mayr), themselves parasitising *Aulacaspis rosae* (Bch.) on raspberry. No males were observed.

Couturier (A.) & Robert (P.). **Maintien de la direction de vol chez *Melolontha melolontha* L. (Coléopt. Scarabeidae).**—*C.R. Acad. Sci.* **240** pp. 2561–2563, 9 refs. Paris, 1955.

Observations in eastern France are recorded showing that adults of *Melolontha melolontha* (L.) taken in flight in the evening and released again under various conditions resume their original direction of flight provided that the sky above them is visible. This is probably due to orientation in flight by diffused polarised light, and may explain the behaviour noted in tests with smoke screens [*cf. R.A.E.*, A **44** 106].

Louw (B. K.). **Mites on Wheat in the Orange Free State.**—*Fmg in S. Afr.* **30** no. 353 pp. 351–352. Pretoria, 1955.

In August–September 1954, a severe outbreak of a Tetranychid mite, probably *Petrobia latens* (Müller) (*lapidum* (Hammer)) or a closely related species, occurred on wheat in the Ladybrand and Ficksburg districts of the Orange Free State. The crop had been sown in May–June and was 2–5 ins. high at the time of attack. The mites were found on both surfaces of the leaves, from which they sucked the sap, causing them to become yellow and wither. Various malathion sprays were applied from an aeroplane to plots on 16th September, and these reduced the mite population by about 20–25 per cent. in one day. By 7th October, no mites were present in any of the treated or untreated plots. Though drought conditions had prevailed from the first appearance of the mites, the wheat survived the attack and there was little difference in growth between treated and untreated plots.

Hartwig (E. K.). **Control of Snouted Harvester Termites.**—*Fmg in S. Afr.* **30** no. 353 pp. 361–366, 19 figs. Pretoria, 1955.

Considerable areas of grass veldt in the Orange Free State are infested by *Trinervitermes* sp. [*cf. R.A.E.*, A **39** 142], and the author gives an account

of studies on the nesting habits of these termites, their various castes and experiments on control, carried out near Glen in 1952–54. Seasonal activity in nests was studied from samples of nest contents taken regularly by means of a soil-sampling tube inserted almost horizontally into the upper and lower portions of the mound. Comparison of temperature readings taken at the same times indicated that the termites tended to concentrate in that part of the nest where the temperature was lowest in summer and highest in winter, but this tendency was not sufficiently reliable to be used as a basis for timing the destruction of nests so as to kill the greatest number of termites. Nymphs that give rise to alate reproductives were present in the nests as early as April when the summer rains had begun in October and from June when they had begun in November. Adult alate reproductives appeared at the beginning of the rains and were present for only 2–3 weeks before dispersing. Each colony had a radius of activity of about 30 ft. round the nest, and the various grass species within this area were collected indiscriminately. In addition to the presence of deserted supplementary mounds [*cf. loc. cit.*], an important factor contributing to the increase in population on poorly-covered veldt appeared to be the consistently higher temperature of the upper 2 ins. of soil in them. A difference of 5°C. [9°F.] was recorded in the day temperatures throughout the year between over-grazed and well-managed veldt.

Methods of destroying the mounds are briefly discussed [*cf.* **39** 143], and a special bladed digging iron, which is plunged into the base and used to lever the mound from the ground, is described. In February 1953, the subterranean parts of individual nests exposed by this method were treated with 0·5 lb. of a 20 per cent. methyl-parathion dust, about 2 lb. of a dust containing 2 per cent. nicotine, or 1 gal. of an emulsion concentrate containing 0·03 per cent. parathion. After four months there was no activity in 100, 80 and 42 per cent. of the nests treated with the three products, respectively, whereas exposed nests that had not been treated with insecticide were all rebuilt to about one half their original size. In a second test, in July, exposed nests were dusted with 0·5 lb. 1·5 per cent. methyl parathion, 0·5 lb. 5 per cent. DDT or about 2 lb. 2 per cent. nicotine. After four months, the termites were active in 68, 72 and 24 per cent. of the nests, respectively, as compared with 93 per cent. of those exposed but not dusted. In a third test, in October, the tops of the mounds were opened with picks and 2 gals. 2 per cent. nicotine solution poured into each. After four months, the termites were active in 85 per cent. of these nests and in 93 per cent. of those that had been opened but not treated. The poor results in the last two tests are attributed to the presence of alate reproductives at the time of treatment.

Control without destroying the mounds would be less expensive. The introduction of 1 lb. methyl bromide per nest, through a ½-in. hole at the base of the mound, which was subsequently sealed, had no immediate effect in October 1953, but resulted in complete mortality of the termites within six months, having apparently destroyed their symbiotic gizzard protozoa. In tests with dieldrin similarly applied on 13th April 1954, all the termites were dead after two months in all of ten nests treated with 1 or 2 pints of a 1:22 aqueous dilution of an emulsion concentrate containing 15 per cent. dieldrin, and all were dead after eight months in nine out of ten and in all of ten treated with 1 and 2 pints, respectively, of a wettable-powder suspension prepared from 1 oz. 50 per cent. dieldrin in 4 gals. water. Activity remained normal in untreated nests. In view of these results, treatment with dieldrin is recommended, and it is thought likely that the residual effect of this insecticide will prevent the re-use of mounds that have been treated with it, so that they need not be destroyed at once.

Hesse (P. R.). **A chemical and physical Study of the Soils of Termite Mounds in East Africa.**—*J. Ecol.* **43** no. 2 pp. 449–461, 1 fig., 17 refs. London, 1955.

The following is based partly on the author's summary. The results are given of a chemical and physical study of soil samples from 56 mounds made by termites of the genus *Macrotermes* in East Africa. The termites concerned were *M. bellicosus* (Smeath.) in Tanganyika, Kenya and Uganda, *M. goliath* (Sjöst.) in Tanganyika and *M. natalensis* (Hav.) in Uganda, and both inhabited and uninhabited mounds on ten types of soil were examined. The results showed that termite mounds are built from the subsoil and that termites do not directly alter or affect the chemical characteristics of the soil, with the possible exception of base exchange capacity and total exchangeable bases. Physical measurements confirmed that termite mounds are merely heaps of subsoil, but showed an altered soil structure. This is due directly to the method of building. The main factors affecting the composition of mound soils were found to be the nature of the nearby subsoil, the environment of the mounds and whether or not they were inhabited. The fact that a mound may have been built by one of three species of termite makes no difference. Neither the presence of termite bodies nor that of the vegetable matter collected had any lasting effect on the fertility of the mound soils. The concretions of calcium carbonate that occur in some mounds were found to be associated with proximity to ground with impeded drainage and are evidently not the result of the direct activities of the termites. The better growth of plants, notably sisal, on termite mounds is due mainly to the better drainage and improved structure of the soil.

Decelle (J.). **Quels sont les insecticides à utiliser contre deux ennemis du caféier d'Arabie,** *Antestiopsis lineaticollis* **et** *Habrochila ghesquierei* **?** —*Bull. INEAC* **4** no. 2 pp. 67–75. Brussels, 1955.

The widespread use of DDT for the control of *Antestiopsis lineaticollis* (Stål) on coffee in the east of the Belgian Congo and Ruanda-Urundi has resulted in increases in the population of the Tingid, *Habrochila ghesquièrei* Schout., presumably owing to destruction of the Mirid, *Apollodotus distanti* Schout., which is an important predator of it. In view of this, experiments were carried out to find an insecticide or combination of insecticides that would control both pests.

In the laboratory, examples of *Antestiopsis* were exposed for five minutes to deposits from insecticidal sprays or dusts, applied at rates equivalent to 90 gals. and 18 lb., respectively, per acre, and were then removed and provided with food. The concentrations, in parts per million, required to give 50 and (in brackets) 95 per cent. mortality were less than 50 (about 60) for parathion, 48 (270) for dieldrin, 73 (230) for Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], 85 (320) for endrin, 108 (245) for aldrin, 120 (more than 500) for malathion, 140 (410) for γ BHC as lindane, 170 (650–700) for DDT, and about 200 for Isolan [1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate]. Other materials, including Dimetan [5,5-dimethyldihydroresorcinol dimethylcarbamate], gave inferior results. A dust mixture of DDT and Dimetan proved more effective than either insecticide alone. DDT, dieldrin and endrin retain their effectiveness for long periods, and would thus be the best for field use. In one plantation in which *Antestiopsis* had been held in check by two or three treatments a year with DDT, an outbreak occurred within 4–5 months after a spray of 0·04 per cent. parathion against *Habrochila*.

In tests with *Habrochila*, the insects were exposed for ten minutes to deposits from sprays and then removed and kept with fresh coffee leaves for

48 hours. The concentrations in p.p.m. required to give 50 and (in brackets) 95 per cent. mortality were 18 (31) for parathion, 31 (62–125) for Diazinon, 48 (140) for γ BHC, and 62 (about 150) for malathion; 95 per cent. kill was given by less than 31 p.p.m. Isolan. The other products tested were inferior. In field tests with sprays, 0·025 per cent. parathion gave complete kill, 0·025 per cent. malathion and 0·05 per cent. γ BHC were satisfactory, and Diazinon, γ BHC and aldrin at 0·025 per cent. and Isolan at 0·015 per cent. were ineffective. The poor results given by Diazinon are attributed to the insufficient wetting power of the formulation used. In tests with dusts applied at about 18–22·5 lb. per acre, 1·5 per cent. methyl-parathion and 2·2 per cent. γ BHC gave good results.

It is concluded that treatment with BHC, which was effective against both pests, or with a mixture of a chlorinated hydrocarbon (normally DDT) to control *Antestiopsis*, and a phosphorus compound or a carbamate to control *Habrochila*, will give the best results. In view of their high toxicity to man, endrin, parathion and Isolan are not recommended for use unless suitable precautions can be taken, and the treatments suggested are BHC and mixtures of DDT with Diazinon, malathion or Dimetan. No tainting of the coffee by BHC was detected.

Harris (W. V.). **An American Termite in imported Timber.**—*Wood* **20** no. 9 pp. 366–367, 1 fig. London, 1955.

The author records the finding of living examples of the damp-wood termite, *Zootermopsis angusticollis* (Hagen), in a parcel of softwoods, believed to be Douglas fir [*Pseudotsuga taxifolia*] from western Canada, imported into Britain, describes the various castes and the habits of the species, which lives in moist rotten logs and old stumps in forests along the Pacific Coast of the United States and Canada, sometimes attacks standing timber and telegraph poles and is very resistant to cold, and briefly reviews earlier introductions of termites into western Europe.

von Rosen (H.). **En för Sverige ny skadegörare,** *Eurytoma* (?) *noxialis* **Portschinsky, på vårvete.** [A new Pest for Sweden, *Harmolita noxialis* on Spring Wheat.]—*Växtskyddsnotiser* 1955 no. 3 pp. 48–50, 2 figs. Stockholm, 1955.

A Eurytomid tentatively identified as *Harmolita* (*Eurytoma*) *noxialis* (Porch.) is recorded for the first time infesting wheat in Sweden. The eggs are laid in early summer in the stems of spring-sown wheat, and the larvae attack the inner walls and suck the sap that exudes. The larvae overwinter in the stubble, and there is only one generation a year. The plants are not killed by the infestation, but growth is abnormal and the yield is reduced by up to 10 per cent. Deep ploughing affords some control.

Papers noticed by Title only.

Davey (J. T.). **The seasonal Migrations and Dynamics of Populations of the African Migratory Locust** (*Locusta migratoria migratorioides* **Reiche and Fairmaire**) **in the Outbreak Area** [on the middle Niger] (**Orth.**).—*Bull. Soc. ent. Fr.* **61** no. 1–2 pp. 18–24, 36 refs. Paris, 1956. [*Cf. R.A.E.*, A **44** 462–463.]

Gardner (K.) & Owen (B. D.). **The Analysis of formulated Schradan Insecticides.**—*J. Sci. Fd Agric.* **7** no. 7 pp. 470–476, 5 refs. London, 1956.

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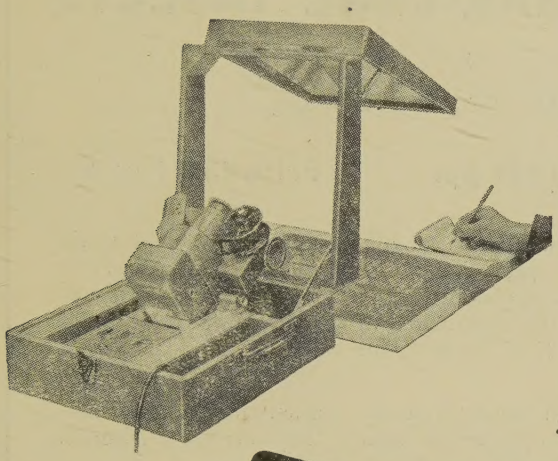

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The second part is a similar catalogue of the parasites and predators; it shows their hosts, the countries in which they attack particular hosts, and those into which they have been introduced.

A bibliography of the principal works consulted, and indexes to countries and genera are given.

Orders should be addressed to the Director, Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7.

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